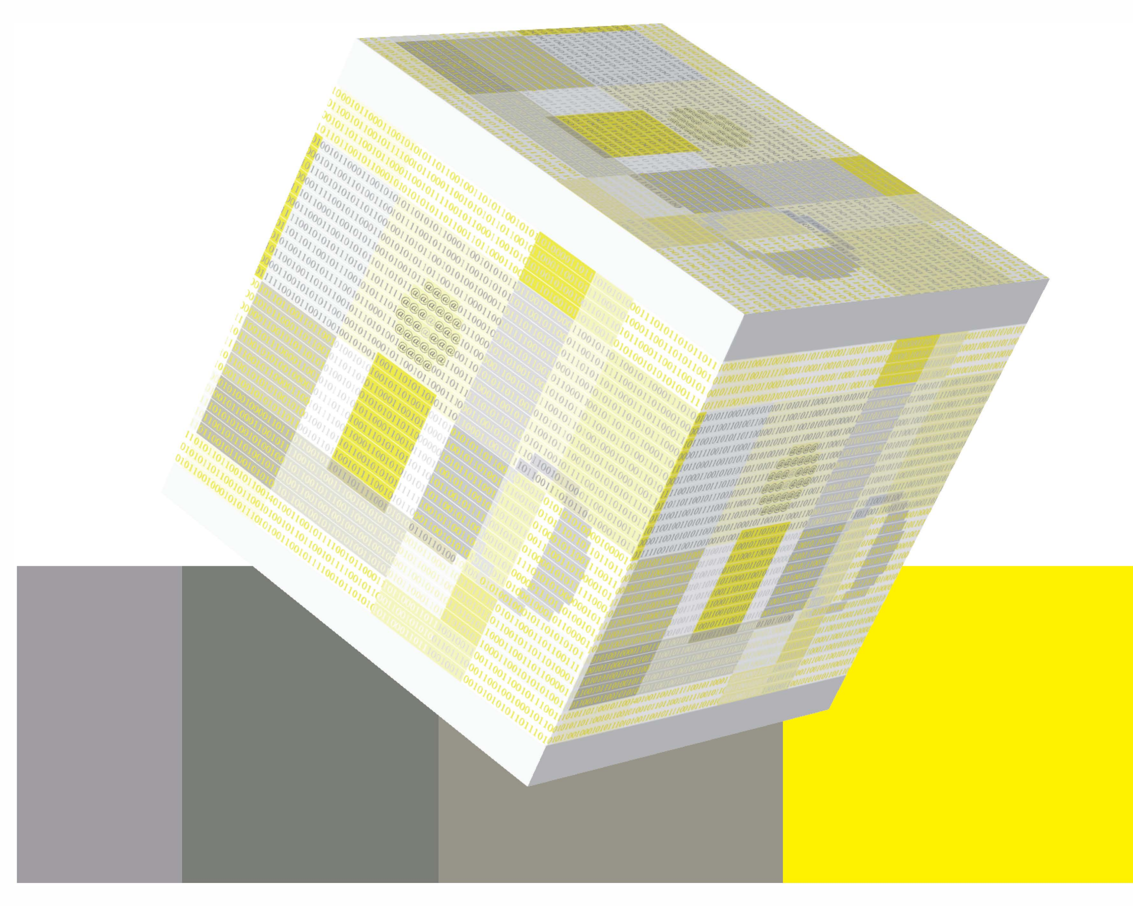
JoEMLS
DOI:10.6120/JoEMLS
ISSN 2309-9100 ISSN-L 1013-090X
CODEN: CYTHD5

教育資料與圖書館學

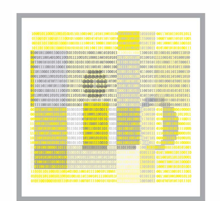
JOURNAL OF EDUCATIONAL MEDIA & LIBRARY SCIENCES

第五十九卷 第二期 二〇二二年
Vol. 59, No. 2, 2022



淡江大學出版中心

教育資料與圖書館學 JOURNAL OF EDUCATIONAL MEDIA & LIBRARY SCIENCES Vol. 59, No.2, 2022



教育資料與圖書館學，始於1970年3月創刊之**教育資料科學月刊**，其間於1980年9月更名為**教育資料科學**，並改以季刊發行。自1982年9月起易今名。另自2016年11月起，改以一年出版三期（3月、7月、11月）。現由淡江大學出版中心出版，淡江大學資訊與圖書館學系和覺生紀念圖書館合作策劃編輯。本刊為國際學術期刊，2008年獲國科會學術期刊評比為第一級，2015年獲科技部人文社會科學研究中心評定為教育學門專業類一級期刊。並廣為海內外知名資料庫所收錄(如下英文所列)。

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教育資料與圖書館學
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本刊係採開放存取（Open Access）與商業資料庫付費途徑，雙軌發行之國際學術期刊，兼具電子版與紙本之平行出版模式。本刊除秉持學術規範與同儕評閱精神外，亦積極邁向InfoLibrary寓意之學域整合與資訊數位化理念，以反映當代圖書資訊學研究趨勢、圖書館典藏內容與應用服務為本；且以探討國內外相關學術領域之理論與實務發展，包括圖書館學、資訊科學與科技、書業與出版研究等，並旁及符合圖書資訊應用發展之教學科技與資訊傳播論述。

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教育資料與圖書館學

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EDITORIAL

Opportunities for Deepening the Reform of the Metadata Elements of Journal Articles

The metadata of journal articles generally refers to information regarding journal name, volume and issue number, article's title, name(s) of author(s), keywords, page range, etc. However, in order to help readers enhance their understanding of article contents when searching for articles, most journal publishers and database organizations present the above metadata together with the abstract of the article to facilitate readers to quickly identify its content. For scholarly articles, in addition to the academic value of the text itself, the references cited by the authors in the texts have significant research value in all the issues in scholarly communication and publication. The references not only present the author's exploration and recognition of previous scholarship, but also assist future generations to further discover scientific trajectories and disseminate scholarly knowledge through the cited references.

Although open access (OA) to academic journals continues to flourish in the global academic community, most academic publishers focus on the open access and availability of full-text digital files of articles. In contrast to the opening of digital files, the release of metadata and their subsequent use are still awaiting the discussion and efforts of the industry, government, and academia. In order to implement the concept of OA, some groups have advocated opening up the abstracts, together with the references, in articles in recent years, as a result of which two initiatives, the Initiative for Open Citations (I4OC) and the Initiative for Open Abstracts (I4OA), have come into being. Of the two, the I4OC even hopes that academic publishers or journal publishers, under the premise of providing free bibliographic data, can provide references at the same time, so as to promote the release of citation data in a structured, separable, and open-access condition, and then proceed to build a copyright-free academic citation database.

At the present stage, most of the search fields provided to readers in the academic literature databases or official websites established by journals in Taiwan are such metadata as journal name, volume and issue number, article's title, name(s) of author(s), keywords, and page range, but not including the element of references. If readers want to retrieve the reference literature, they must first confirm whether full-text downloading is permitted before further downloading the electronic file of a single article, from which they make the

searches and checking; or readers must leave the search interface of the literature database or journal website and navigate to the Taiwan Humanities and Social Sciences Citation Index Database (free search) or Scopus and Web of Science (subscription required) to do their searches and checking, without being able to obtain the research information needed at a one-stop location. It is hoped that academic publishers and journal publishers can work together with the government and private databases, striving to integrate the complete metadata of Taiwan's academic journals and gear them to international standards, so as to enhance the professional image of Taiwan's academic publishing.

In this issue (Issue 2, Volume 59), 10 manuscripts have gone through the review process. Two manuscripts were rejected at the internal review process for format evaluation. Eight manuscripts have gone through the whole review process, and four were accepted, with a rejection rate of 50% (4 out of 8). The articles published in this issue include: "To Use or Not to Use? Exploring the Factors Influencing Professional Reusers' Intention to Adopt and Utilize Governmental Open Data in Taiwan" by Tung-Mou Yang and Yi-Jung Wu, "Effects of Afterschool Programs in Public Libraries on Disadvantaged Children: The Case of the New Taipei City Library" by Ya-Wei Chuang and Hui-Yun Sung, "Exploring Article Process Charge of Open Access Journals from the Perspectives of Publication Characteristics and Citation Impact Indicators: A Case Study in the Medical Field" by Chia-Yu Lin and Wen-Yau Cathy Lin, and "Estimation of Topic Similarity and Its Application to Measuring Stability of Topic Modeling" by Sung-Chien Lin. Special thanks are dedicated to the reviewers and authors.

Jeong-Yeou Chiu
JoEMLS Chief Editor



教育資料與圖書館學　59 : 2 (2022) : 97-100
DOI:10.6120/JoEMLS.202207_59(2).editorial



編者言

深化期刊書目欄位之改革契機

期刊文章的書目資料（metadata）一般所指為期刊名、卷期數、文章篇名、作者姓名、關鍵詞、頁碼等資訊，但為能夠協助讀者在查檢文章時，提升對於文章內容的理解度，多數期刊出版者及資料庫機構會在呈現上述書目資料時，連同該篇文章的摘要一併呈現，方便讀者快速識別文章之內容。對於學術性文章而言，除了內文本身所帶來的學術價值，其作者在內文所引用的參考文獻，更是在整個學術傳播及出版議題中，佔有相當重要的研究價值。參考文獻不僅能夠呈現出該篇作者對於先前學術研究之探索及認可外，更能夠協助後人藉由所引用的參考文獻，而進一步發現科學軌跡及傳播學術知識。

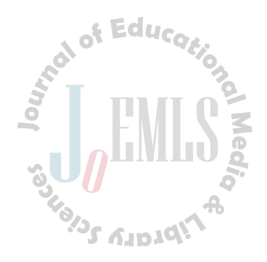
儘管學術期刊開放取用（Open Access，簡稱OA）在全球學術界持續興盛運行，但各家學術出版商大多專注在文章全文數位檔案之公開及取得。相較於數位檔案的開放，文章書目資料的釋出以及後續運用，卻仍待產官學三界的討論及努力。為了能夠貫徹OA此一概念，近年來亦有團體倡導將文章中的摘要與參考文獻一併開放，因而開放引文（Initiative for Open Citations，簡稱I4OC）以及開放摘要（Initiative for Open Abstracts，簡稱I4OA）等兩項倡議亦應運而生。其中I4OC更是希望學術出版社或期刊出版方在免費提供書目數據之前提下，同時間提供參考文獻，促進引文數據能夠以結構化、可分離和開放取用的狀態釋出，進而建置無著作權限制的學術引文資料庫。

以台灣現階段的學術文獻資料庫或是期刊自行建置之官方網站，其所提供給讀者檢索之欄位大多為期刊名、卷期數、文章篇名、作者姓名、關鍵詞、頁碼等書目資料，但卻不包含參考文獻此一書目欄位（element）。若要查檢參考文獻，則必須先確認是否允許全文下載後，才能進一步單篇下載電子檔，再從中檢索、查閱；又或是讀者須離開文獻資料庫或期刊網站之檢索介面，額外至臺灣人文及社會科學引文索引資料庫（可免費查詢）或Scopus及Web of Science（採訂閱付費使用）等引文索引資料庫進行查檢，而無法一站式取得所要之研究資訊。期待未來學術出版社及期刊出版方能與政府及民間資料庫業者攜手合作，整合台灣學術期刊之完整書目資料並與國際接軌，藉此提升台灣學術出版專業形象。

本卷期（59卷2期）評閱作業含前置編務審查作業共計10篇稿件，完成外審評閱作業流程之退稿篇數為四件，另有兩篇因形式審查不通過而退稿，最後僅保留四篇大作刊登，也使得本卷期退稿率達到50%。這次得以順利刊出的學者大作為：Tung-Mou Yang與Yi-Jung Wu “To Use or Not to Use? Exploring the Factors Influencing Professional Reusers’ Intention to Adopt and Utilize Governmen-

tal Open Data in Taiwan”、莊雅葳與宋慧筠「公共圖書館課後輔導對弱勢兒童之影響：以新北市立圖書館為例」、林家鈺與林雯瑤「從出版特徵與引用影響指標探討開放取用期刊文章處理費：以醫學領域為例」，以及林頌堅「主題相似性估計與其在主題建模穩定性測量之應用」。衷心感謝所有投稿者與審稿者的辛勤奉獻，本人謹此致意。

邱 炯友
教育資料與圖書館學 主編



Journal of Educational Media & Library Sciences 59 : 2 (2022) : 101-135
DOI:10.6120/JoEMLS.202207_59(2).0001.RS.BE



Research Article

To Use or Not to Use? Exploring the Factors Influencing Professional Reusers' Intention to Adopt and Utilize Governmental Open Data in Taiwan

Tung-Mou Yang[a*] Yi-Jung Wu[b]

Abstract

In recent years, open government data has become one of the prevailing policy implementations among government administrations around the world. Researchers maintain that open data providers and users play critical roles in forming a sound open data ecosystem. However, recent studies have found that open data use has not kept up with expectations, with the number of open data applications increasing slowly. Therefore, using a qualitative research approach to focus on professional reusers, this study explores the determinants that influence professional reusers' intention to use governmental open data. With qualitative empirical data support, the identified determinants include perceived usefulness, perceived effort, external influence, facilitating condition, legislation and license, self-efficacy, and perceived risk. In addition, the determinants are incorporated into the theory of planned behavior to investigate how the determinants act as behavioral, normative, and control beliefs in influencing professional reusers' intentions. Further, this study discusses related suggestions that can strengthen the sustainability of an open data ecosystem. The discussion and practical implications of this study are expected to provide insights to both practitioners and policymakers for further developing open data policies and enriching the current open data–related literature.

Keywords: *Open data, Open government data, Open data use, Open data users, Influential factors, Taiwan*

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Please visit JoEMLS website to read the Peer Review Report (Open Point) and Article Summary (InSight Point) of the article.
2022/01/10 received; 2022/07/28 revised; 2022/07/30 accepted

Introduction

Government agencies are perceived as entities possessing various resources that can be shared and utilized across the boundary of the public and private sectors. In particular, while government agencies are usually considered the largest data creators and collectors across a nation's different domains, open government data in recent years has gradually become an important policy implementation adopted by government administrations around the world (World Wide Web Foundation, 2018). The number of countries with open data portals has increased significantly from 46 in 2014 to 153 in 2020 (United Nations Department of Economic and Social Affairs, 2020). Open data refers to the concept in which datasets are published online in electronic forms that are machine-readable and with a non-proprietary format, and the datasets can be freely accessed, used, modified, and shared by anyone at any place for any purpose (The World Bank, n.d.). The goal of open government data is to enhance the fundamental principles of open government, including transparency, participation, and collaboration, by ensuring public engagement in using governmental open data. The public is expected to utilize governmental open data to generate innovative data usage and applications, spur economic growth, and bring positive impacts to society (Attard et al., 2015; Janssen et al., 2012; Janssen & Zuiderwijk, 2014). A common belief maintains that when government agencies publish more datasets on open data platforms, the public will be motivated to reuse the datasets. However, recent research indicates that open data use has not kept up with expectations, although related infrastructure, such as open data platforms, has been available online to provide services (Najafabadi & Luna-Reyes, 2017; Zuiderwijk et al., 2016). In addition, there are difficulties in obtaining people's participation in using governmental open data. The public seems to agree with an open data movement but does not necessarily engage in reusing the published datasets (Hellberg & Hedström, 2015). While open data users play a critical role in forming a sound open data ecosystem, if the projected data users do not use the published datasets, the objective of open data initiatives can be futile (Attard et al., 2015; Hivon & Titah, 2017). Therefore, it is necessary to understand the factors that influence people's engagement in using governmental open data.

Researchers have recently classified open data users into two categories: direct reusers and end users (Abella et al., 2019). Direct reusers can be professional reusers and social reusers. Professional reusers refer to entrepreneurs and private companies that use open data to innovate and create for-profit products and services. Social reusers represent non-profit organizations such as NGOs providing services to others. On the other hand, end users mean entities, organizations, or citizens consuming open data–related products and

services provided by direct reusers. In addition, researchers have suggested that there should be more open data studies conducted in different contexts, such as sources, areas, and countries, to explore the use of governmental open data and how related open data policies can be further developed (Magalhães & Roseira, 2016; Susha et al., 2015; Zuiderwijk & Hinnant, 2019). Even to this day, there is still limited research on open data use focusing on professional reusers in the context of Taiwan's open government data. Therefore, this research explores and discusses open data use from the perspective of Taiwan's professional reusers using governmental open data to develop for-profit business applications. Specifically, the following research questions are investigated in this exploratory study: 1. What are the critical factors influencing professional reusers' intention to use governmental open data? 2. What is the nature of the impact of these factors? 3. What strategies can be employed to sustain an open data ecosystem based on the perspective of professional reusers?

The rest of the paper is organized as follows. In the following section, the global open data movement is first briefly introduced. Then, the recent literature on open data research and open data use is reviewed, and the proposed research is subsequently presented. Next, the paper describes the research design and methods of this study, in which the employed case, data collection, and data analysis are presented. Then, the paper discusses the findings and implications of the empirical data analysis. Lastly, the conclusion section expounds on the contribution and limitations of the current study. Future research directions are also suggested.

Literature Review

The Movement of Open Government Data

In this global movement, the U.S. government first established its open data portal in 2009 to provide data access to its federal government agencies. Open government data became an important pillar in supporting the information-centric strategy of the U.S. digital government (Digital Government, n.d.). The OPEN Government Data Act (Open, Public, Electronic, and Necessary Government Data Act) was further enacted, requiring U.S. federal agencies to make datasets open online by default in a form that is machine-readable and freely reusable (H.R.4174 –115th Congress [2017-2018]: Foundations for Evidence-Based Policymaking Act of 2018, 2019). Similarly, in 2010 the U.K. government initiated its open data portal to release datasets of its central and local government agencies. A government report, the Open Data White Paper, was published in 2012 by the U.K. government to emphasize the potential of publishing governmental open data to achieve transparency and accountability (UK Minister of State for the Cabinet

Office, 2012). By the end of 2012, The European Union (EU) also established its open data portal, allowing the public to access data released from EU agencies and institutions. An Open Data Charter was signed in 2013 by the Group of Eight (G8) leaders to promote the principles of open government data, including open data by default, quality and quantity, usable by all, improving governance, and enhancing innovation. In 2014, the leaders of the largest G20 industrial economies agreed to use governmental open data as a tool against corruption. The Open Government Partnership, dedicated to making government administrations more open, accountable, and responsive to citizens, also enacted its Open Data Charter by the end of 2015 to provide open data principles to its member countries. Notably, the Charter has been adopted by 79 national and local governments from around the world (Open Data Charter, 2021). According to the 2020 United Nations E-Government Survey, the number of countries implementing open government data policies has been growing steadily, and 153 countries have established their respective open data portals (United Nations Department of Economic and Social Affairs, 2020). Likewise, intergovernmental organizations such as the United Nations, OECD, and World Bank have initiated open data sites and projects to provide the public access to their datasets.

The Recent Research on Open Government Data

Researchers from different disciplines, such as information science, information management, public administration, computer science, and law, have explored the complexity of open government data from various perspectives and knowledge areas (Hossain et al., 2016; Zuiderwijk & Hinnant, 2019). Government agencies appear to have a risk-averse culture and act conservatively in opening their datasets (Peled, 2011). As the World Wide Web Foundation (2018) indicates in its Open Data Barometer report, the vast majority of governmental datasets remain closed to the public. The progress of embedding open data policies is slow, and governments still treat open data as a side project. Another recent study also indicates that most of the published government resources on open data sites are informational data rather than granular data, and only a small number of the datasets advertised as open data are actually open (V. Wang & Shepherd, 2020).

Therefore, from the perspectives of technology, organization, legislation and policy, and environment, researchers have studied and discussed related social and technical enablers and impediments that have an impact on government agencies in implementing open data policies (Barry & Bannister, 2014; Conradie & Choenni, 2014; Janssen et al., 2012; Yang et al., 2015). It is indicated that the reuse of governmental data can be an obscure policy domain, and the interrelation between open data and other policy areas is complicated (Bates, 2014).

Meanwhile, government agencies tend to lack clear guidelines for publishing open data to external parties. Researchers suggest that it is important to create a system and enact policies to promote the release of open data by reducing the social, economic, and political impacts that government agencies may encounter (Gerunov, 2017; Nugroho et al., 2015). For instance, Zuiderwijk and Janssen (2014) proposed a framework to improve the development of both new and existing open data policies by taking in perspectives of environment, policy content, and performance evaluation. Dawes et al. (2016) developed a general model for planning open data programs using an ecosystem approach to address various perspectives of open data initiatives, including policy and strategy, data publication and use, feedback and communication, and stakeholder interactions.

In addition, researchers investigated the emerging open data business models to understand their characteristics, patterns, and strategies used to create economic opportunities (Zeleti et al., 2014). Different types of infomediary business models driven by governmental datasets were identified (Janssen & Zuiderwijk, 2014). In terms of open data assessment, measurement frameworks were developed to evaluate the maturity and progress of open data initiatives in government administrations (Chu & Tseng, 2016; Solar et al., 2012; Yang & Wu, 2019; Zhu & Freeman, 2019). Further, related indexes were also developed for the evaluation and categorization of open data portals and their metadata qualities (Kubler et al., 2018; Thorsby et al., 2017). Similarly, the Open Knowledge Foundation and World Wide Web Foundation also built their own benchmarks—the Global Open Data Index and the Open Data Barometer—to evaluate the open data developments of global government administrations.

The Use of Governmental Open Data

Researchers have indicated that publishing data alone is not enough to enable the life cycle of open government open (Attard et al., 2015). After data publication, data users must be able to discover and access data for data consumption. Likewise, according to Dawes et al.'s (2016) open data ecosystem model, one of the key stakeholders are users who utilize open data in conducting analyses and developing applications. In addition to government agencies acting as data providers, data users play a critical role in the success of open data initiatives. Therefore, there is a need to better understand the interaction between government agencies and open data users, considering its sustainability is crucial to the development of an open data ecosystem (Hivon & Titah, 2017).

A recent study has identified five major motives for open data use, including exploring creativity, creating business value, enabling local citizen value, addressing global societal challenges, and advocating the open data agenda (Lassinantti et al., 2019). It is indicated that individuals' open data use can be

influenced by policies, processes, and infrastructure used to provide open data (Susha et al., 2015). In particular, impediments may exist while users attempt to access and use datasets (Zuiderwijk et al., 2012). A recent investigation points out that many open data portals are still in a very early stage of development, and a great deal of work is needed to help the public understand and use data (Thorsby et al., 2017). While open data use includes activities to search, identify, and download datasets, open data portals should also make the related processes easier to facilitate users in obtaining datasets (Dawes et al., 2016). In particular, a machine-readable and non-proprietary format is essential to enable easier access and unrestricted use (Attard et al., 2016).

Researchers have indicated that users' trust in the quality of open data weighs on whether the users would engage in using datasets (Purwanto et al., 2020; Zhu & Freeman, 2019; Zuiderwijk et al., 2016). Open data without proper quality control may jeopardize dataset reuse and bring negative impacts on civic participation (Weerakkody et al., 2017). Thus, the importance of metadata of published datasets is also emphasized; it is expected to help in the use of open data by enhancing user experience (Zuiderwijk et al., 2016).

It is suggested that open data infrastructure should maintain mechanisms to respond to the questions, problems, and suggestions raised by open data users (Purwanto et al., 2020; Zhu & Freeman, 2019; Zuiderwijk et al., 2016). Communication channels allow open data users to request datasets and report errors for government agencies to improve the quality of the released datasets (Yang et al., 2015; Zuiderwijk et al., 2016).

Researchers have further argued that outdated laws and policies could prevent data from being used to create value. For instance, the inexistence or inconsistency of licensing in the datasets across different jurisdictions could have an impact on open data use (Attard et al., 2016; Magalhães & Roseira, 2016). Thus, detailed information should be provided for users to understand how open data can be used in compliance with related licenses and regulations (Kaasenbrood et al., 2015).

It is also found that the availability of citizens' resources matters in open data use (Purwanto et al., 2020). The lack of fundamental skills and expertise for processing and analyzing data could act as an impediment to utilizing open data for generating values (Magalhães & Roseira, 2016; Safarov et al., 2017). In order to promote the public adoption of open data, it is suggested that required skills and expertise be made available to help open data users participate further (Safarov et al., 2017; Susha et al., 2015).

Conceptualizing the Adoption of Open Data Use

Open government data can be considered an innovative e-government service that allows the public to adopt and use open data for respective purposes

without restriction. The public using open data needs to go through the processes of data discovery, data exploration, and data exploitation (Attard et al., 2015). When accessing and utilizing open data, users have to adapt to various open data technologies within an open data infrastructure, including open data portals, related application programming interfaces, various data formats, linked data vocabularies, and metadata elements (Zuiderwijk et al., 2015). Accordingly, as an emerging innovative service in the public sector, open government data must obtain the public's participation and collaboration in forming a sound open data ecosystem; the public's adoption of using governmental open data can be conceptualized as a process of innovation acceptance. Specifically, the unified theory of acceptance and use of technology (UTAUT) is a commonly utilized framework that helps discuss technology and innovation acceptance. Its four constructs are performance expectancy, effort expectancy, social influence, and facilitating condition (Venkatesh et al., 2003). The four constructs are suggested to influence a user's intention to accept an innovative system or technology. Performance expectancy refers to the degree to which an individual believes that using a system or technology will help achieve gains in performance. Effort expectancy refers to a system or technology's degree of ease to use. Further, social influence means the degree to which an individual thinks that important others suggest them to use a system or technology. Facilitating condition refers to the degree to which an individual believes that an organizational and technical infrastructure or related resources are there to support the use of a system or technology.

As aforementioned, researchers suggest that while open government data is a complex phenomenon, investigations should also take into account the environment and legal context in which related stakeholders reside (Zuiderwijk & Hinnant, 2019). In addition, derived from the perspective of behavioral psychology, self-efficacy refers to an individual's perception of their ability to plan and execute certain actions to produce specific performance and reach a particular goal (Bandura, 1977). In the e-government literature, researchers have suggested that a user's self-efficacy matters in the adoption and use of e-government services (Hung et al., 2013; Rana et al., 2015). They emphasized that users could consider their capabilities, which is expected to affect whether or not they adopt and use innovative e-government services.

Furthermore, based on the field of social psychology, the theory of planned behavior represents a well-established framework that embraces and discusses various factors that affect an individual's intention to perform a certain behavior (Ajzen, 1991). In particular, the theory of planned behavior has also been extensively adopted by e-governance researchers in discussing users' intention

toward the adoption and use of innovative government services (Hung et al., 2013; Ozkan & Kanat, 2011; Rana et al., 2015, 2016; H.-J. Wang & Lo, 2013). For instance, Hung et al. (2013) used the theory of planned behavior to identify the factors determining users' intention to use governmental mobile services. Rana et al. (2015, 2016) utilized the theory's concepts to explore how influential factors affect citizens' adoption of e-government systems. H.-J. Wang and Lo (2013) also used the theory as a theoretical framework to investigate the factors influencing citizens' intention to use government websites. According to Ajzen (1991), the framework suggests that an individual's behavioral intention is a function comprising three antecedent constructs: attitude toward the behavior, subjective norm, and perceived behavioral control. Specifically, attitude toward the behavior refers to the degree to which the performance of a behavior is either positively or negatively evaluated. In addition, it can be determined by an individual's behavioral beliefs. A behavioral belief refers to the subjective probability that a given outcome or experience can be generated by performing a behavior. On the other hand, subjective norm means the perceived social pressure to engage or not to engage in a behavior. It is pointed out that subjective norms can be determined by an individual's normative beliefs. A normative belief is defined as the reflection of an individual's perceived expectations from other individuals, groups, and organizations to engage in a particular behavior. Lastly, perceived behavioral control refers to an individual's perception of their capability to engage in a given behavior. It is suggested to be determined by control beliefs, which are the perceived presence of factors that may help or hinder an individual's ability to perform a behavior.

The Proposed Research

While the number of governmental datasets that have been opened to the public keeps growing, the number of applications using open data also increases slowly (Najafabadi & Luna-Reyes, 2017; Zuiderwijk et al., 2016). Researchers point out that there are difficulties in obtaining people's interests in using open data. Although the public seems to like the idea of open government data policies, they do not actively participate in the process of data use (Hellberg & Hedström, 2015). The lack of users exploiting open data resources indicates the need to understand what factors influence open data use and what strategies attract and stimulate users to participate (Attard et al., 2015; Zuiderwijk et al., 2016). Researchers also suggest that there should be more studies that explore open data adoption in different contexts, such as areas, sources, and countries, to understand the various factors that influence open data usage of different types of data reusers (Magalhães & Roseira, 2016; Susha et al., 2015). Findings within different socio-technical contexts can help extend the knowledge of how open

data policies could be further developed and implemented (Zuiderwijk & Hinnant, 2019). Therefore, this research explores the influential factors of open data use from users' perspectives in the context of Taiwan's open government data. The aforementioned frameworks are expected to help conceptualize the factors that explain the phenomenon of interest with empirical data support. In particular, while one of the major motives of open data use is to create business value, this study focuses on professional reusers who utilize governmental open data to develop innovative applications for business services.

Research Design and Method

Since the inception of the Freedom of Government Information Law in Taiwan, the Taiwan government has gradually institutionalized related practices for the public to access government information and data. In particular, the open government data movement has received significant attention from both public and private sectors in Taiwan. Taiwan's central and local government agencies have implemented open data policies and established open data infrastructure, such as open data sites, to open their datasets. In November 2011, the Taipei City government established Taiwan's first open data website (https://data.taipei). On the other hand, New Taipei City also made the debut of its open data portal (https://data.ntpc.gov.tw) in December 2012. While recognizing the critical role and value of an open government, at the end of 2012, the Prime Minister of Taiwan required the Research, Development, and Evaluation Commission to devise and enact open data policies at the central government level. Subsequently, Data.gov.tw made its debut in April 2013 and acted as the open data portal for the central government agencies of Taiwan. Under an executive order from the Prime Minister, each central government agency of Taiwan was required to open at least fifty datasets by the end of 2013. The number of total datasets available on Data.gov.tw is currently 57,275 (as of June 12, 2022), which has grown significantly compared to the number of datasets several years ago (3,187 datasets as of December 10, 2014). Meanwhile, the other four city governments of the six major municipalities of Taiwan, including Taoyuan City, Taichung City, Tainan City, and Kaohsiung City, have enabled their respective open data portals to provide services. Most of the other local governments have also participated in the open data policy implementation. Noteworthily, the Taiwan government has received high rankings in the Global Open Data index for two consecutive years in 2016 and 2017—proof of the Taiwan government's efforts in implementing open data policies. Further, in forming a sound open data ecosystem, the Taiwan government has also engaged in promoting open data use through various activities, such as workshops, hackathons, and open data contests. Hence, given

its efforts and commitment to implementing open data policies and promoting the use of open data, the context of Taiwan's open government data presents one of the good cases for conducting this exploratory research.

In addition, regarding open data user studies in the context of Taiwan's open government data, Lo et al. (2014) first employed a survey approach to explore data users' perceptions of related legislations and policies, sharing approaches, technological standards and data formats, open data scopes, and open data promotion. Similarly, other researchers utilized the survey approach to investigate the factors that may influence data users' satisfaction and intention of open data adoption—that is, information quality, user interface quality, computer self-efficacy, and social influence (Chen, 2015; H.-J. Wang, 2020). H.-J. Wang and Lo (2019) also used a survey approach and indicated the importance of top management support and competitive pressure for firms' adoption of governmental open data. However, there is still limited research focusing on professional open data reusers in the context of Taiwan's open government data using a semi-structured interview approach to discuss in-depth qualitative findings. Accordingly, as previously mentioned, this study is expected to fill this research gap.

The major challenge in this research is the difficulty in identifying and connecting open data users. According to the open data principles, governmental open data sites can be accessed by anyone from any place at any time without registration. Therefore, the researchers of the study found it relatively difficult to identify and approach professional reusers who use governmental open data to develop for-profit business applications. Consequently, a purposive sampling approach was applied to locate relevant candidates for conducting interviews. Notably, purposive sampling is usually employed for selecting information-rich cases to conduct in-depth qualitative studies (Wengraf, 2001).

In promoting open data use, the Industrial Development Bureau of the Ministry of Economic Affairs (the IDB of MOEA) has been the responsible central government agency for holding an annual event for an open data contest. Held by the agency for several years, this contest is one of the major government-held events for promoting open data use, attracting professional reusers who use open data for conducting various business applications. The major aim of the contest is to invite and encourage entrepreneurs and private companies to develop innovative business applications using governmental open data. The award-winning companies of the contest receive high prizes and consultations from the government to support their business models and applications. Venture capital firms are also invited to the event to invest in the companies they are interested in.

Therefore, the researchers of this study considered this event a great opportunity to approach professional reusers for conducting interviews. After directly contacting the IDB of MOEA, the researchers had the opportunity to attend the convention of the annual contest held on December 6, 2019. The award-winning entrepreneurs and private companies were invited during the convention to present their applications using governmental open data. Thus, the researchers interacted with those award-winning contest participants to recruit interviewees for this study. There were a total of fourteen contest participants who agreed to participate in this study as interviewees.

All recruited interviewees had extensive experience using governmental open data in developing business applications. In their respective companies, they held key positions, such as product manager, chief executive officer, chief technology officer, chief operating officer, technical director, general manager, and vice president. Particularly, the interviewees were from various business industries and used a variety of open government data, such as geographic data, custom data, health, and medical data, weather data, economic data, traffic data, transportation data, tourism data, and legal case data. With various professional backgrounds and experience in using governmental open data, the interviewees provided rich information to the researchers in this exploratory research. In addition, while the interviewees of this study were recruited from private companies of different business industries, it also helped achieve the goal of multiple sources of evidence to enhance the quality of the obtained qualitative empirical data.

Subsequently, the interviews were conducted between March and April 2020. This study employed a semi-structured interview to collect qualitative empirical data, given its flexibility to follow up on new information and explore new findings (Bryman, 2004). The interview questions were designed to lead the interviewees toward helping the researchers identify the answers to the research questions. The interviews were recorded using digital recorders and field notes and were transcribed for later data analysis and report writing. The average duration of interviews was about one hour and thirty minutes.

During data analysis, the researchers adopted qualitative data analytic techniques to analyze data and identify common patterns. The utilized techniques were open coding, axial coding, and selective coding (Strauss & Corbin, 1998). The interview data were reviewed and analyzed line by line during the open coding process. The initial codes were associated with the text segments extracted from the interview data, representing the concepts derived from the data. Subsequently, axial coding refined, aligned and classified the initial codes generated in open coding. Conceptually similar codes were then grouped to

form categories. Lastly, selective coding was employed to select and interpret the relationships of the categories of concepts from axial coding and confirm whether the elaborations and interpretations were inherent in and comply with the observed phenomena of this study. Atlas.ti was utilized in this study to analyze the qualitative data.

Findings

Based on the empirical data analysis, seven influential factors were identified in this study: perceived usefulness, perceived effort, external influence, facilitating condition, legislation and license, self-efficacy, and perceived risk, which are in line with the concepts in the aforementioned literature for conceptualizing the adoption of open data use. With qualitative empirical data support, the seven identified factors are discussed in the following subsections.

Perceived Usefulness

The interviewees indicated that perceived usefulness is important when first adopting and using governmental open data. They expected that the obtained open datasets could benefit their existing business operations by reducing cost and increasing efficiency. In particular, open data is free for all to access, and the published datasets may include a variety of fields, such as weather data and geographic data, which can be extremely costly and difficult for small businesses or entrepreneurs to collect by themselves. For instance, an interviewee (Chief Executive Officer, P4_04) explained:

> …The most important help is that governmental open data helps us reduce significant operational costs. It was fairly difficult for us to obtain geographic data. For instance, it is impossible for my company to investigate the geographic distribution of fault lines by itself. We have to admit that we don’t have the capability and resources to collect such data…. (Chief Executive Officer, P4_04)

Some interviewees further pointed out that, for some datasets, such as legal cases involving car accidents, ridership of subway stations, and company registrations, the government is the public authority to collect and generate the datasets and is usually the only data source that the interviewees claim they have to rely on.

While one of the major goals of open government data is to unleash the potential of governmental datasets to spur innovations and economic growth, some interviewees also pointed out that open data use could act as a core catalyst that drives innovative business models. They expected that open data could be integrated with their own datasets to generate applications through dataset mashups. For instance, an interviewee (Chief Technology Officer, P24_06) stated:

> …Open data usually represents raw datasets, which means there are plenty of opportunities that you can dig or mine some things from the datasets by combining other datasets or resources that you might already have at hand. For instance, we use the open data of xxx government agency to predict the trend of material supply and demand that can be very valuable information to our clients…. (Chief Technology Officer, P24_06)

However, many interviewees indicated that government agencies had not opened their needed datasets. A significant gap remains between what the government agencies have opened and what the open data users expect to use. For instance, the interviewees said that some government agencies do not provide their datasets through open data approach. Instead, those agencies provide web information systems for the public to check governmental datasets online. Nevertheless, those systems need human operations to input search criteria by hand, and only limited data records can be retrieved at each query.

In addition, some interviewees pointed out that their perceived usefulness of open data gradually decreases as they gain more experience using some of the published datasets. The interviewees also claimed they were not satisfied with the data quality. It is indicated that the current data quality of some datasets, such as accuracy, completeness, granularity, and timeliness, could not meet data users' expectations. For instance, some datasets might quickly become obsolete and contain erroneous data, while their update frequencies remain relatively low. The interviewees said that using the datasets, they could generate wrong data analysis results or provide inaccurate services to their clients. The interviewees also pointed out that they need raw rather than processed datasets. Some interviewees even argued that they would decide not to use governmental open data and turn to look for other alternatives by themselves. For instance, some interviewees stated the following:

> …We have been thinking whether we can use xxx agency's open data to drive innovation and enhance our business operation. However, it is a pity that the current datasets opened by the agency are really trivial. Honestly, the datasets are not useful to fit our need…. (Chief Technology Officer, P24_06)

> …In my opinion, the data update frequency seriously matters. If the datasets are updated on a daily basis, the data can be very useful to fit our needs. Nevertheless, if it takes two or three months to update the datasets just once, well, I don't see we can benefit from using the datasets…. (Chief Executive Officer, P3_03)

> …Government agencies have opened many datasets, which cover a variety of different areas such as transportation, health, weather, and tourism. However, the depths of most of the datasets are relatively shallow and do not really fit our needs. What we need may be just a specific area of data; nevertheless, we care much more about the depth of data such as its details and comprehensiveness…. (Chief Executive Officer, P2_02)

Perceived Effort

The interviewees suggested perceived effort as another important factor that must be considered. They mentioned that they have to evaluate whether they can afford the needed time and resources for using open data. As the interviewees claimed, the process of data access and data cleaning can be time-consuming, making it challenging for them to obtain and use the datasets they need. Governmental open datasets could be scattered in different places rather than on a single portal, so the interviewees had to spend significant time on searching government websites to look for datasets. For instance, an interviewee (Chief Executive Officer, P2_02) explained:

> …We attempt to retrieve the datasets from the unified open data portal, data.gov.tw. However, some government agencies may just have their datasets published on other open data–related sites or just on somewhere of their respective agencies' websites. Therefore, we have to spend lots of effort on finding those datasets from different channels, and sometimes we even need to develop web crawlers to parse data from agencies' websites or their online databases…. (Chief Executive Officer, P2_02)

In addition, the interviewees suggested that most of the datasets in the open data portals are static data in open formats, such as CSV, JSON, or XML, which meets the three-star requirement of the open data schema. They also mentioned encountering the problem of determining when the datasets may be updated. Further, they pointed out that having no notification mechanism is relatively inconvenient, requiring them to revisit the sites frequently for possible updates. This situation also poses a challenge for the interviewees in obtaining up-to-date datasets. For instance, an interviewee (General Manager, P5_07) stated:

> …We retrieve many different datasets from the open data sites. However, we have no idea when the datasets may be updated. It doesn't really make sense for us to designate someone to frequently check the sites to see whether new datasets are available. In the industry, we are more used to connecting API for real-time data exchange rather than a traditional file downloading…. (General Manager, P5_07)

Furthermore, the interviewees pointed out that government agencies opened their datasets with inconsistent formats and fields, a tremendous challenge in developing business applications that require processing and integrating open data of different central and local government agencies with the same core businesses. Some interviewees explained:

> …According to our experience in processing transportation datasets of different local government agencies, we notice that some datasets have more data fields and some have very limited data fields. What is worse is that two datasets may contain data fields having the same names but with totally different definitions. Another problem is that the datasets may adopt different character encodings. Therefore, humans checking to view through the datasets become inevitable, and this process is very labor intensive. It is difficult for us to clean and integrate datasets through automatic machine processing…. (Vice President, P23_05)

> …We try to enhance our tourism application by using governmental open data. However, the tourism datasets actually come from agencies of different local governments, and the datasets have different formats and fields. I would say those datasets are really fragmented and fairly difficult for us to integrate. We are frustrated, and it is unrealistic for us to apply the datasets to develop application functions that could be available only in some cities. What if our app users plan to travel across cities?…. (General Manager, P5_07)

Moreover, some interviewees pointed out that even an agency may open a dataset that has inconsistent data representations among the data records. An interviewee (Product Manager, P7_09) gave an example:

> …Even within the same dataset, a data field may have different representations. For instance, in the address data field, some records may use traditional Chinese characters to represent floor and address numbers, and some records may use English characters such as 'f' or 'F' and Arabic numerals. The address field also contains different symbols, punctuation marks, and abbreviations, which can be very confusing. There is no authority control…. (Product Manager, P7_09)

External Influence

External influences can be conceptualized as the driver derived from the professional reusers' surrounding environment, emphasizing the importance of open data policy and encouraging open data usage to establish a sound open data ecosystem. The interviewees indicated that external influences could foster their

perception of the importance of open data and draw their intention toward using open data. In particular, it was determined that external influences could be in the forms of international open data trends, social groups, government promotions, and peer organizations. Some interviewees pointed out that they have been following the international movement of open government data, which initially raised their interest in considering using governmental open data. An interviewee (Chief Technology Officer, P24_06) said:

> …We have been observing the international trend of open data development. For instance, we notice that the U.S. has done a very good job in opening some datasets that are related to our business, which then becomes a driver that we start observing the related development in Taiwan and attempting to initiate the following adoption and use…. (Chief Technology Officer, P24_06)

The interviewees also pointed out that in the past few years, Taiwan non-governmental organizations and social groups have been promoting the transparency of government information and the use of open data through civic activities such as hackathons that attract both IT professionals and non-IT individuals. This trend forms a positive atmosphere that encourages business and non-profit organizations to adopt open data for innovative usage and social good. While most interviewees are from the software and information technology industries, they indicated they are influenced by related non-profit organizations and social groups through shared ideology and expectation to consider using governmental open data. An interviewee (Director, P8_10) explained:

> …We are indeed influenced by social communities. Particularly, as software engineers, we do like the ideas of an open system, open source, and open data that promote the principles of transparency and sharing. When we need to look for datasets to use, open data then becomes one of the options that draw our attention, and we would take it into consideration…. (Director, P8_10)

Similarly, the Taiwan government has designated agencies to promote open data use through various activities such as workshops, international forums, and open data contests. While the interviewees are within the information technology industry, they indicated that they could be influenced by government policies and would attempt to see whether they could meet the expectations of the policies. Accordingly, some interviewees admitted that they are influenced by the government in evaluating the feasibility of using governmental open data in their business operations. An interviewee (Chief Executive Officer, P9_11) stated:

> ...I would say that the promotion and encouragement from the government raised our initial interests toward open data use. Then, we became interested in knowing open data further. Nevertheless, it still takes time to see whether open data can really fit into our business model.... (Chief Executive Officer, P9_11)

Some interviewees suggested that they can also be influenced by their peer group. It is indicated that when they know that other individuals or companies in their industries have been utilizing open data to enhance operation and productivity or develop innovative applications, they tend to act more seriously in considering whether they should use open data further.

Facilitating Condition

Furthermore, the interviewees claimed that it would have a positive influence if they received resources and facilitation from others in their surrounding environment to support their open data use. It is indicated that the obtained resources and facilitation can help reduce the interviewees' perceived cost of using governmental open data. Accordingly, they become motivated to set higher priorities for using open data in developing business applications. An interviewee (Vice President, P23_05) described:

> ...Well, for a company, using governmental open data can be viewed as a kind of trial and investment, and there is a cost for using open data. Through the contest, we are fortunate to receive monetary reward and consultation from the government, which becomes a driver for us to consider using open data further.... (Vice President, P23_05)

Interviewees also explained that they would like to use open data further in their business applications. However, while one of the core parts of business applications relies on rich data sources, the interviewees pointed out that they looked forward to obtaining more facilitation from the government in terms of interacting with government agencies to access more open data that fit their needs.

Legislation and License

As professional reusers, the interviewees indicated that their major purpose in using open data is to develop business applications. Therefore, the interviewees asserted that they needed to carefully review whether related regulations and licenses were clear and appropriate to guide their open data usage in their respective business domains. An interviewee (Chief Executive Officer, P3_03) explained:

> ...Practically, when we apply any third-party dataset to our business application, we have to study its license carefully. We need to figure out to

> what extent we can legally use the dataset for business purposes without any violation of regulations.... (Chief Executive Officer, P3_03)

Furthermore, the interviewees suggested that the Taiwan government has gradually developed its open data license by following the principles of Creative Commons 4.0. Noteworthily, the license has been widely adopted by both central and local government agencies in open data initiatives. However, some interviewees pointed out that the Taiwan government has not yet enacted specific open data law. Government agencies are encouraged but not necessarily required to open their datasets. Without specific open data law, the interviewees claimed that when they attempted to request more open data from certain government agencies, they encountered challenges resulting from the complex bureaucratic system and other existing legislations, such as the Personal Data Protection Act and the Charges and Fees Act. The existing legislations and regulations became barriers, hindering their intentions to use open data further. An interviewee (Product Manager, P7_09) gave an example:

> ...We have been requesting a dataset regarding the information of the nationally registered physicians and the clinics and hospitals where the physicians currently practice. However, the responsible government agency keeps turning down our request and asserts that this dataset could violate Personal Data Protection Act. However, clinics and hospitals usually publicly publish the information of their affiliated physicians on websites. Patients also need to know the information when they want to make appointments. We are really puzzled and still can't obtain the dataset to develop our application.... (Product Manager, P7_09)

Self-Efficacy

The interviewees suggested that not everyone has the capability to access and use open data directly. In addition to the commonly seen open formats such as CSV, XML, and JSON, open data can consist of other specialized formats and structures, and domain expertise is usually needed to clean, integrate, and interpret datasets. Accordingly, the interviewees pointed out that in order to use governmental open data, they must possess sufficient abilities in terms of data analysis and software engineering in their respective domains. In particular, as professional reusers running business services, the interviewees maintained that they are proficient IT developers and maintain high-level domain knowledge in their respective fields, implying their confidence in possessing the required capability to obtain governmental open data for developing business applications. Some of the interviewees stated the following:

> …Running a data processing company, we would say that domain expertise and technical skills all have very important influences on our company's open data adoption. It can be directly related to our confidence in using open data.…. (Chief Technology Officer, P24_06)

> …Well, because of our domain knowledge, we know how to interpret the datasets and apply them to our software applications. Without sufficient domain knowledge, we will have difficulty using open datasets. Similarly, if we don't have coding ability, we will not be able to analyze the datasets and don't know how to use the datasets for value-added purposes…. (Vice President, P23_05)

Perceived Risk

As professional reusers, the interviewees indicated that it could pose a great risk if they solely rely on open data as the only one or the major data source to develop business applications. The interviewees pointed out that their current open data had quality issues. In particular, the interviewees mentioned that using the database could provide inaccurate services to their clients that might incur consumer complaints and damage their companies' reputations. Similarly, using the datasets to develop strategic business plans may lead to wrong analyses and predictions and result in potential operational losses. The interviewees described the phenomenon:

> …There is a very high possibility that inaccurate data records exist in the open datasets that we adopt to develop applications. Our company could suffer loss and receive complaints from the application users. Our clients can become less confident in using our applications, and our intention to use open data further is negatively influenced…. (Chief Executive Officer, P2_02)

> …Government agencies may update their internal databases at any time to reflect their daily operations. However, some datasets on the open data portals are not frequently updated, and those datasets can become outdated. By using the datasets, our system could generate poor services and inaccurate results to our app users…. (Product Manager, P7_09)

Although one of the common purposes of open data is to promote innovative applications expected to spur economic growth, some interviewees claimed that they act hesitantly and have serious concerns about applying open data to develop their core business applications. They mentioned that they were uncertain whether their adopted datasets could be continually opened by government agencies. The interviewees further argued that it is possible that some datasets might stop being

opened, which could bring fatal impacts on startups and businesses if they solely rely on using open data to develop their core products. In addition, they pointed out that the potential risk exists, which they are not willing to take. Some of the interviewees stated the following:

> …I personally have many questions regarding a company using governmental open data in its core business model even though the data could be used in a very innovative approach. I think it is extremely risky to do so. Open data can be applied to develop some added features of an application but should not become the core part of the application. If the data is stopped being opened, your business will be severely impacted.…. (Director, P9_11)

> …Honestly, I am not sure whether the datasets can be continually opened and frequently updated. It will be a serious issue if the datasets are no longer opened. You can use open data as a supplement to your application. However, you should not use open data to develop the core part of your business model. Your business could be in jeopardy if the datasets become not opened…. (Chief Executive Officer, P3_03)

Discussion

The Identified Factors and Their Influences

With empirical data support, seven factors were identified through the interviews with professional reusers. Perceived usefulness and perceived effort were found to have the most important influences when professional reusers evaluate whether they would adopt and use governmental open data. By using governmental open data, professional reusers expect to increase the efficiency and reduce the cost of developing business services and applications. Particularly, some open data are derived from the domains that private companies are not permitted to or are not capable of collecting by themselves. Therefore, professional reusers tend to have high expectations toward using governmental open data and expect to use the datasets to drive and develop new business models or enhance their existing business services. Still, a significant gap remains between what government agencies have opened and what professional reusers look for. It was found that professional reusers' perceived usefulness toward open data use could gradually decrease. At the same time, they remain unsatisfied with the quality of the retrieved datasets in terms of accuracy, completeness, granularity, and timeliness, which are critical data criteria that professional reusers must obtain to provide applications of high business value.

Similarly, perceived effort weighs when professional reusers find that they indeed have to spend considerable time and resources on the processes of data access, data cleaning, and data integration, which seriously contradicts their original expectation of increasing efficiency and reducing operational costs using governmental open data. As identified in this study, different central and local government agencies of the same core business usually open datasets with inconsistent data formats, data fields, and metadata information, which poses a huge challenge for professional reusers in integrating the published datasets of various government agencies for developing business applications. This issue in data inconsistency can greatly increase professional reusers' perceived efforts of using governmental open data. However, automatic and machine-operated data processing becomes very difficult to practice.

Furthermore, it was also found that professional reusers are still evaluating the long-term feasibility of using governmental open data in their business services. They are also concerned about its potential risks, which can further hinder the government's expectation of unleashing the potential of governmental datasets to spur business and economic growth. In the short term, professional reusers are afraid of creating inaccurate and flawed services resulting from data quality issues, which may negatively impact their companies' reputations. In the long term, professional reusers expect to use governmental open data to develop applications for long-lasting business services rather than just for a one-time side project. Therefore, professional reusers act hesitantly and are concerned about applying governmental open data to the core part of their business models and applications, as they are uncertain whether their current datasets can be continually opened in the foreseeable future.

Due to professional reusers' surrounding environment, external influences were also found to come from international open data trends, social groups, government promotions, and peer organizations to influence professional reusers' intention toward open data use. Nevertheless, external influences tend to act as catalysts for professional reusers' initial interest and intention toward using governmental open data. The strength of external influences can gradually decrease as professional reusers begin using the datasets. Then, their perceived usefulness, perceived effort, and perceived risk would weigh more.

In addition, facilitation from professional reusers' surrounding environment can help reduce costs and motivate their open data use. In particular, for professional reusers running startup companies, monetary reward and consultation from the government and experience-sharing from other organizations can encourage them to use governmental open data. Professional reusers expect more facilitation from government agencies to help them obtain more open datasets that meet their needs in developing business applications.

Furthermore, professional reusers also need to verify whether their open data usage complies with related legislations and licenses because their major purpose of using open data is to develop commercial applications. However, this study found that a complex bureaucratic system and existing legislations and regulations can sometimes become barriers that restrain professional reusers from requesting more open data from government agencies.

Moreover, professional reusers were found to maintain a high level of self-efficacy. In particular, they showed confidence in possessing sufficient domain expertise and technical skills for using governmental open data. This result may contradict the argument in some open data studies that technical skills and expertise should be available to facilitate and promote open data use. In fact, the general public represents end users, who usually do not directly utilize governmental open data. End users usually rely on the services and applications provided by professional reusers, who are the direct reusers and have the sufficient capability to use governmental open data. Therefore, for professional reusers, it is still more important to focus on enhancing their perceived usefulness and alleviating their perceived effort and perceived risk to promote the use of governmental open data.

The Implications and an Integrated View of the Factors

Among the identified factors, perceived usefulness, perceived effort, external influences, and facilitating conditions correspond to the concepts of the UTAUT, a technology acceptance model. Particularly, according to the qualitative empirical data, the two most commonly discussed concepts of the technology acceptance model—perceived usefulness and perceived effort—were found to have the most important influences on professional reusers' intention to use governmental open data. Therefore, exploring the antecedent factors that may influence perceived usefulness and perceived effort is worth pursuing. As discussed in the literature review, professional reusers' use of governmental open data can be conceptualized as a process of innovation acceptance by adapting to the open data infrastructure. Accordingly, the quality aspects, such as data quality and system quality, of the utilized open data portals and related information systems can be considered the potential antecedent factors influencing professional reusers' perceived usefulness and perceived effort. The quality factors are also expected to affect professional reusers' perceived risk of using governmental open data—another factor identified in this study but not originally discussed in the technology acceptance model.

In addition, according to the empirical data analysis, professional reusers' perceived usefulness of using open data tends to decrease after using the obtained datasets. External influences also tend to act as an initial catalyst, and the strength of the factor gradually decreases after professional reusers use the datasets.

Therefore, it is assumed that the influences of the identified factors are expected to vary as the time of professional reusers' open data usage proceeds and the related using experience accumulates. Accordingly, a longitudinal study can be another potential research strategy that can be applied to study the phenomenon further.

Similarly, as discussed in the literature, other types of open data users still exist, such as social reusers and end users (Abella et al., 2019). It is also possible that the identified factors can have different influences on the other types of users. It is assumed that open data users—impelled by different motivations, such as exploring creativity, creating business value, enabling local citizen value, addressing global societal challenges, and advocating the open data agenda as described by Lassinantti et al. (2019)—may assign different weights to the identified influential factors. For instance, among the different types of open data users, professional reusers may tend to maintain higher self-efficacy toward their open data use than other users, such as social reusers and end users.

From an integrated view, the identified factors can be further incorporated with Ajzen's (1991) theory of planned behavior to represent behavioral beliefs, normative beliefs, and control beliefs that determine professional reusers' attitudes, subjective norms, and perceived behavioral control toward governmental open data use (see Figure 1). According to the theory of planned behavior, professional reusers' attitudes can be determined by different behavioral beliefs, which represent the subjective probabilities that given outcomes can be produced by the behavior. In this study, perceived usefulness, perceived effort, and perceived risk are conceptualized as the outcomes resulting from professional reusers' engagement in using governmental open data. The three factors can represent either positive or negative outcomes of performing the behavior. Accordingly, the three factors can act as professional reusers' behavioral beliefs in determining their attitude toward open data use.

In addition, subjective norms are determined by normative beliefs, which refer to the perceived behavioral expectations from other individuals, groups, or organizations. In this study, the identified external influences result from social groups and the government. As the interviewees indicated that they could be influenced by social groups' ideology and the government's open data policies, they would consider meeting their expectations. Therefore, external influences from social groups and the government can be related to professional reusers' perceived behavioral expectations and act as the normative belief that determines their subjective norms toward open data use.

Furthermore, perceived behavioral control is determined by different control beliefs, which refer to the factors that may either facilitate or hinder the behavior. In this study, facilitating conditions, existing legislations and regulations, and self-

efficacy can either benefit or impede professional reusers' use of governmental open data. Therefore, the three factors are assumed to act as professional reusers' control beliefs determining their perceived behavioral control over open data adoption. As shown in Figure 1, incorporating the theory of planned behavior, a synthesized view is presented to see how the identified factors act as behavioral, normative, and control beliefs that influence professional reusers' intention toward using governmental open data. This synthesized view of the identified factors is expected to provide a foundation for later survey-based quantitative research.

Figure 1. A Synthesized View Integrated with the Theory of Planned Behavior

Moreover, the findings suggest that there is still a significant gap between what government agencies have opened and professional reusers' expectations. Apparently, there are blurred areas that must be addressed further. Meanwhile, ambiguities and conflicts might exist between the concept of an open government, hindering the publication of more datasets to achieve transparency, participation and collaboration, and the concept of traditional stewardship in which government agencies are required to govern their datasets strictly. It is indicated in the literature that governmental open data is defined as non-privacy-restricted and non-confidential data, generated using public money and made available for the public to access without restrictions (Janssen et al., 2012). However, when different open datasets are merged to provide integrated information, information could infringe privacy and confidentiality (Yang et al., 2015). Researchers also suggest that it is critical to find a balance and resolve the potential contradictions between open government data policies and other public values, such as trust, transparency, privacy, and security (Meijer et al., 2014). Similarly, as Dawes (2010) has pointed out, stewardship and usefulness should be two broad and

complementary information principles. The principle of stewardship protects government information from damage, loss, or misuse and is concerned with the assurance of responsibility, validity, and legitimacy. On the other hand, the principle of usefulness encourages exploration, application, and innovation. It makes government information more accessible and easier to obtain and be used by various public and private users. It is suggested that the two principles should be considered to help balance the many considerations critical for achieving greater government transparency and realizing the public value of government information (Dawes, 2010).

The Practical Implications of This Study

According to the empirical findings, government agencies may have dedicated efforts to open datasets. However, many of the opened datasets do not meet professional reusers' needs for developing business applications, and many datasets professional reusers expect to use are still not opened by government agencies. Therefore, there is a need to bridge the gap by enhancing professional reusers' perceived usefulness of using governmental open data. The following list presents the practical implications of this research:

- Government agencies should maintain appropriate communication channels for obtaining comments and feedback from professional reusers regarding their data usage experiences and expectations. For instance, government agencies of different business domains should hold public workshops, meetings, and forums to provide professional reusers with the opportunities to interact with the agencies and express their data needs. Through this approach, government agencies can also benefit from having a clearer direction in terms of what datasets to open with higher priority.
- According to the Pareto principle (the 80/20 rule; Koch, 1999), 20% of the opened datasets may represent those most professional reusers are interested in using. Therefore, government agencies can investigate what datasets are most frequently downloaded and utilized by open data users. Then, government agencies can explore whether those datasets meet data users' expectations and whether more related datasets can be opened further.
- There is a need to reduce professional reusers' perceived effort of using governmental open data. Government agencies should be continually encouraged to use the unified open data portal to publish their open data information, which can help simplify professional reusers' processes of data search and data access. In addition, a vertical coordination mechanism can be established among the central and local government agencies with the same core businesses. For each business domain, a responsible central government

agency can coordinate to create a standardized template that other government agencies may adopt in opening their related datasets. Through standardization, the barriers to open data use resulting from inconsistent data formats, data fields, and metadata information can be reduced when professional reusers use open datasets of different central and local government agencies with the same core businesses. Similarly, for some central government agencies that could open similar datasets, a horizontal coordination mechanism may be enabled to set up a unified window for opening datasets. Consequently, professional reusers' uncertainty regarding which datasets they should use can be decreased, while those similar datasets usually come with inconsistent data content and have different update frequencies.

- When opening their datasets, many government agencies merely put the links of their published datasets on open data platforms for users to download. However, this approach is still inconvenient for professional reusers because a manual operation is needed to download data files. This approach also poses difficulty in obtaining up-to-date data. Thus, it is preferred that government agencies consider using open API to open their datasets. In this way, professional reusers can automate the process of connecting their information systems to open API and assign customized query parameters to retrieve up-to-date data, which can help professional reusers create high business value applications. It is expected that the approach of an open API can greatly increase professional reusers' perceived usefulness and reduce their perceived effort in using governmental open data.
- Government agencies should continue improving the quality of their published datasets, which is critical to enhancing professional reusers' perceived usefulness of open data use. A collaborative data feedback model can also be established, which allows professional reusers to collaborate with government agencies to improve open data quality. In some data domains, professional reusers may be willing to clean, refine and supplement their retrieved open data to generate more comprehensive datasets with better data quality in terms of accuracy, completeness, and timeliness. The data feedback model allows professional reusers to provide enhanced datasets back to government agencies with some open licenses or subscription fees. Meanwhile, government agencies can benefit from obtaining better quality datasets and re-releasing the datasets to the general public. Further, this approach can encourage private sectors, such as entrepreneurs and startups, to participate in the process of open data preparation and refinement through the existing infrastructure and foundation of open government data.

- Another similar approach suggests that the government should facilitate the formation of a data market while professional reusers act as the role of data intermediary in their respective business domains, as some literature has also suggested (Mercado-Lara & Gil-Garcia, 2014; Schrock & Shaffer, 2017; Van Schalkwyk et al., 2016). Based on the foundation of open government data, professional reusers can directly provide their refined datasets to the general public and other businesses as a free public service or commercial service with fees. Through this approach, professional reusers acting as data intermediaries can help improve the quality of governmental open data with added values and make it easier for others to use open data.

  While data intermediaries are capable of providing data services with enhanced data quality and guaranteed sustainability based on the existing infrastructure of open government data, this approach could be an alternative for direct data reusers who are willing to subscribe to the service, particularly for those who tend to have high perceived risks of directly using governmental open data. Data intermediaries can dedicate their efforts to interacting with the data reusers to assist their data usage requirements and problems. This strategy also helps reduce the loading that government agencies might have to deal with. Particularly, in addition to the current free open data service, it is also worth exploring whether government agencies can consider offering service contracts with reasonable fee charges as an alternative for professional reusers seeking government agencies to provide dedicated data services such as large volume and specialized data access.
- This study found that external influences and facilitation conditions matter. Thus, the government should continue promoting open data use through various activities, including workshops, forums, hackathons, and contests, which can spur professional reusers' initial interest in using governmental open data. Through the activities, government agencies can also provide more facilitation to professional reusers such as entrepreneurs and startups to assist their open data use. Furthermore, as aforementioned, while professional reusers usually maintain a high level of self-efficacy in their domain knowledge and technical skills, a well-established mechanism that professional reusers can interact with the agencies to express their feedback and data needs is the "true facilitation" that professional reusers look forward to receiving.
- In terms of legislation and policy, a designated open data law should be enacted. Such a law not only provides clearer guidance and acts as the foundation for government agencies to implement open data policies but also helps professional reusers reduce their perceived risk and retain their confidence

in using governmental open data concerning its long-term sustainability and that government agencies will commit themselves to continually open datasets. Enacting open data law can also help professional reusers counter the institutional barriers resulting from a complex bureaucratic system and other existing legislations and regulations when attempting to interact with government agencies to request more open datasets.

- Public and private collaboration is another approach that government agencies can consider to encourage professional reusers to use open data (Susha et al., 2017, 2019). Specifically, government agencies can invite professional reusers to help resolve the pressing challenges using governmental open data. Government agencies can also collaborate with professional reusers to open more datasets during the process. In this way, professional reusers can have the opportunity to develop solutions that meet the needs of government agencies. If government agencies are satisfied with the developed solutions, this public and private collaboration can also present an opportunity, allowing professional reusers to later market the developed solutions as business services to other government agencies or companies in the industry.
- While governmental open data should not include datasets that may infringe personal privacy and national security, another approach to bridging the gap between what government agencies have opened and what professional reusers expect to obtain is the help from open data committees, which have been set up in most central government agencies in Taiwan. The composition of open data committees can include representatives of government agencies, private and public sectors, social groups, academia, and individual citizens. The committees are expected to help determine whether some governmental datasets that professional reusers request should be opened. Therefore, the designated function of open data committees in respective government agencies should be well exercised in considering the principles of stewardship and usefulness—the two aforementioned complementary information principles proposed by Dawes (2010).

Conclusion

A sound open government data ecosystem should include both open data providers and users. Meanwhile, this research explores and discusses the factors determining professional reusers' intention to use governmental open data. With qualitative empirical data support, the identified factors are perceived usefulness, perceived effort, external influence, facilitating condition, legislation and license, self-efficacy, and perceived risk. Particularly, perceived usefulness and

perceived effort are the two major factors derived from professional reusers' data usage experience. Professional reusers also consider the perceived risk of using governmental open data for developing business applications in terms of long-term data sustainability. As proficient IT developers in their respective domains, professional reusers maintain a high level of self-efficacy toward open data use. However, external influences and facilitation conditions from their surrounding environment must also be taken into consideration. Similarly, existing legislations and regulations within the bureaucratic system affect professional reusers when attempting to interact with government agencies to request more open data. In addition, the identified factors are integrated with the theory of planned behavior to present how the factors determine professional reusers' intention of using governmental open data through behavioral, normative, and control beliefs. Furthermore, the discussion and implications of this study can provide insights to researchers, practitioners, and policymakers regarding potential research directions and how open data policies can be further developed and implemented to attract open data users. This study conducted in the context of Taiwan's open government data is expected to enrich the current open data–related literature.

However, there are limitations in the current research. This study uses a qualitative approach, in which potential research biases could occur while some parts of the interview data may be emphasized more and some could be neglected. Similarly, this research uses a purposive sampling approach to recruit relevant interviewees for conducting interviews, through which potential sampling bias might also occur. Accordingly, there should be more research for exploring the complexity of open data use in different data areas, social contexts, and countries. In addition, as aforementioned, future research can explore the factors influencing different types of open data users, such as social reusers and end users. Furthermore, it would be interesting to investigate whether the factors may have different levels of impact on different types of open data users. Moreover, quantitative research can also be employed to evaluate the strengths of the factors identified in this study.

Acknowledgements

The authors are grateful to the editors and the three anonymous reviewers for providing thoughtful comments to help the authors revise and improve the paper. The authors also thank all the interviewees for participating in this research and offering valuable qualitative empirical data to help the authors finish this research project. This study was financially supported by the Ministry of Science and Technology, Taiwan (107-2410-H-002-165-MY2) and by the Universities and Colleges Humanities and Social Sciences Benchmarking Project (Grant no. 111L9A002).

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教育資料與圖書館學　59 : 2 (2022) : 101-135
DOI:10.6120/JoEMLS.202207_59(2).0001.RS.BE



研究論文

我國政府開放資料使用者之資料使用意願影響因素探討：以商業使用者為例

楊東謀[a*]　吳怡融[b]

摘要

開放資料於近年來已成為國內外政府機關施政的重要方針之一，期以達到政府透明化與公眾參與之目標外，也鼓勵公眾進行資料創新應用，以促進經濟與新創產業之發展。然當政府機關已經逐步開放資料集之後，開放資料的使用端上卻有不如預期之情形。因此，本研究是以我國政府開放資料的推行現況作為研究場域，嘗試探究哪些因素會影響商業與新創等公司業者於政府開放資料的使用意願，經由質化實證資料分析所得之影響因素為預期有用性、預期投入、外部影響、協助情況、法令政策、自我效能與預期風險。此研究結果與實務討論可以做為我國相關政策研擬與推行之參考，以期增進資料使用者的持續參與，並可對於他國分享我國政府開放資料的推行經驗。

關鍵詞： 開放資料，政府開放資料，開放資料使用，開放資料使用者，影響因素，台灣

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2022/01/10投稿；2022/07/28修訂；2022/07/30接受


Journal of Educational Media & Library Sciences
JoEMLS

教育資料與圖書館學　59 : 2 (2022) : 137-168
DOI:10.6120/JoEMLS.202207_59(2).0010.RS.AM



公共圖書館課後輔導對弱勢兒童之影響：以新北市立圖書館為例[ψ]

莊雅葳[a]　宋慧筠[b*]

摘要

本研究旨在探討台灣公共圖書館課後輔導對弱勢兒童的影響，以突顯公共圖書館支持社會正義的價值。本研究為質性研究，以訪談法為主，觀察法為輔蒐集資料，研究對象包含：22位兒童、13位家長、八位志工及七位館員。本研究結果顯示：㈠家長對兒童參與公共圖書館課後輔導的原因為：家長缺乏陪伴時間、家庭學習環境不佳、課業需求及餐券的誘因。㈡兒童參與公共圖書館課後輔導活動的內容主要為寫作業與自行閱讀，其他活動則視志工的安排，例如：共讀、課業輔導、美勞、遊戲等。㈢公共圖書館課後輔導對兒童的影響包含：培養閱讀習慣、提升閱讀興趣、學業表現進步、拓展學習視野、增進人際互動、習得禮儀及提升心理狀態。

關鍵詞：公共圖書館，課後輔導，弱勢兒童，質性研究

前　言

課後輔導為支持父母安心就業，協助父母對兒童的照顧和教導，避免兒童在放學後發生安全問題，並促進兒童的身心發展。新北市政府社會局曾調查國小兒童放學後至晚餐前的時間安排狀況，結果顯示超過六成的兒童有參加課後輔導（校內外課後照顧班、補教機構或社團活動），其中約五成的兒童參加營利機構辦理的課後輔導（黃河，2018）。然而，並不是所有家庭都有足夠經濟能力支付營利機構課後輔導的費用，對於經濟狀況較差的弱勢家庭來說更是難以負

[ψ] 本文改寫自莊雅葳的碩士論文「公共圖書館課後輔導對於弱勢兒童之影響—以新北市立圖書館為例」。

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此篇文章之同儕評閱意見報告（Open Point）及導讀簡報（InSight Point）請至本刊網站查閱
2022/04/13投稿；2022/06/20修訂；2022/07/05接受

擔，因此政府與非營利機構辦理的課後輔導對弱勢家庭來說是相當大的支持，能縮減家庭獲取課後輔導資源的落差（蘇秀枝，2005）。

在台灣，許多機構（例如：政府機關、非營利組織）投入弱勢兒童的課後輔導，有些機構因為場地不足或計畫需求而借用圖書館的場地進行活動（劉鎮寧，2013），然而，觀察台灣公共圖書館的兒童服務，發現自行辦理課後輔導的公共圖書館並不多。本研究的案例為台灣第一個將課後輔導納入常態性服務的新北市立圖書館（黃思維，2014），以國小一至六年級的弱勢兒童為優先服務對象，弱勢背景涵蓋低收入戶、中低收入戶、社會局轉介高風險家庭及身心障礙。

分析台灣為弱勢兒童辦理課後輔導服務的相關研究，歸納出課後輔導對兒童的成長發展具有正向幫助，包括：學習表現（李孟峰、連廷嘉，2010；湯維玲、蔡佩娟，2013；顏國樑、宋美瑤，2013）、人際關係（孔詢媚，2019；吳文炎，2015）、行為表現（洪清一，2011；唐盈棣，2011）及心理狀況（莊沛蓉，2019；歐怡珍，2010）四個層面。雖然台灣實施課後輔導的公共圖書館不多，僅有臺北市立圖書館（2008至2009年）、新北市立圖書館（2013年至今）、臺南市官田區圖書館（2019年），但公共圖書館扮演著支持兒童學習發展的角色，與其他服務機構相比，其特色為擁有豐富的館藏資源、安全與非正式的學習環境，以及開放時間較長，是很適合辦理課後輔導的場域。再者，從圖書館的服務使命中可以瞭解到圖書館具有社會正義的理念（Pateman & Vincent, 2010），公共圖書館為有需求的兒童提供免費的課後輔導服務有助於實現社會正義，因此需要透過研究，探討這項服務是否對弱勢兒童產生正面效益，以彰顯課後輔導存在於公共圖書館的價值。

台灣的公共圖書館於近十年開始推動課後輔導，而美國公共圖書館的課後輔導計畫在1980年代中期已蓬勃發展（Mediavilla, 2001），因此目前圖書資訊學領域探討課後輔導服務的相關文獻大多來自國外，研究大多著重於探討家庭作業中心的服務規劃與作法（Bevin & Goulding, 1999; Cassell & Walther, 2006; Mediavilla, 2003, 2018），亦有部分研究指出公共圖書館課後輔導對於兒童具有正向影響（Bailey,1999; Huffman & Rua, 2008; Train & Elkin, 2000）。然而，目前尚缺乏研究探討台灣的公共圖書館課後輔導之實際運作情況及其對兒童的影響，為彌補此學術研究缺口，本研究旨在探討台灣公共圖書館課後輔導對弱勢兒童的影響。因此，本研究提出以下研究問題：

㈠家長對弱勢兒童參與公共圖書館課後輔導的原因為何？

㈡弱勢兒童參與公共圖書館課後輔導的活動內容為何？

㈢公共圖書館課後輔導對弱勢兒童的學習表現、人際關係、行為表現與心理狀況的影響為何？

二、文獻探討

㈠ 公共圖書館課後輔導與社會正義

公共圖書館的使命蘊含著社會正義的概念。社會正義並無清楚明確的定義，西方的哲學家已發展出眾多社會正義理論，在眾多理論中持有不同的觀點，造成不同觀點的原因是來自於對「正義」一詞有不同的解釋（Rioux, 2010）。綜合許多觀點，正義具有平等的概念。在圖書資訊學領域中，許多政策及規範皆有提到平等的概念。國際圖書館協會聯盟（International Federation of Library Associations and Institutions [IFLA], 2012）發表的「圖書館員及其他資訊工作者的倫理守則」(IFLA Code of Ethics for Librarians and other Information Workers）提到圖書館必須為社區所有人免費提供平等的資訊取用服務，以確保每個人獲取資訊的權利。在平等的意涵上，圖書館所追求的平等接近實質平等，從多樣性（diversity）作為圖書館的核心價值之一即能瞭解，重視文化與族群的多樣性是平等提供資源與服務的基礎（American Library Association, 2019）。美國圖書館協會的社會責任圓桌會議（Social Responsibilities Round Table, 2019）指出圖書館應盡的社會責任，館員必須關注和瞭解當前的社會問題與不平等現象，進行改善或解決。為了實踐社會正義，Pateman與Vincent（2010）指出圖書館可透過擁護平等與多樣性、提供以需求為導向的服務（needs-based service）、將資源分配給最需要的人、認識與瞭解當地社區、積極參與社區、與社區共同設計圖書館的服務來落實。

公共圖書館實施課後輔導為因應當前的社會需求而發展出的服務方式，促使圖書館關注於兒童在課後活動的需求。隨著社會環境的轉變，家庭型態以雙薪家庭為多數，父母須忙於工作，無法在兒童放學後給予照顧，於是鑰匙兒童（latchkey children）的問題逐漸增加（Dowd, 1989）。美國的公共圖書館實施課後輔導計畫的初始原因為許多鑰匙兒童會在放學後到公共圖書館等待父母，而他們會在圖書館喧鬧、佔位或做出其他破壞秩序的行為，造成館員的困擾，為解決這個問題，並希望讓兒童獲得更豐富的學習體驗，公共圖書館因而開始發展許多課後輔導計畫，讓兒童在放學後有一個安全的地方進行課後活動（Dowd, 1989; Long, 2000; Mediavilla, 2001）。

課後時間的安排與兒童的成長發展有關，除了學校的學習之外，放學後的非正式學習是影響兒童成就差距的原因之一（Hartman, 2011）。政府在推動義務教育之後，所有兒童都能接受到同等的教育，然而，台灣的教育制度越來越強調多元學習，且台灣營利機構的課後輔導相當盛行（何俊青，2014），為了提升兒童的競爭力，許多父母會送孩子去補習班加強學校課業，或去才藝班培養技能，補充學校教育無法提供或不足的部分。由此顯示學習的差異在於放學後，

對於弱勢兒童而言，學習不能只依靠學校，課後的學習是造成學習成就差異的原因，因此社會教育資源的提供就扮演了重要的角色（陳淑麗，2009）。

公共圖書館為有課後輔導需求的兒童提供服務，尤其在經濟和社會較弱勢的地區，或學校及家庭缺乏學習相關資源的兒童特別需要課後輔導的協助，以彌補教育資源的落差（Bevin & Goulding, 1999; Bundy, 2006）。由此可知，公共圖書館滿足社區對於課後輔導的需求，圖書館的服務與資源免費開放給所有人的特性，為發揮社會正義的基礎，有助於改善教育資源不平等的問題。

㈡公共圖書館課後輔導實施與影響

自1980年代中期，美國公共圖書館的課後輔導開始蓬勃發展，許多公共圖書館著手規劃與設計課後輔導計畫（Mediavilla, 2001）。有些美國公共圖書館系統規劃出具系統性及規模性的課後輔導計畫，由所轄分館執行，提供一週四至五天的課後輔導服務，例如：費城自由圖書館（Free Library of Philadelphia, 2020）的LEAP（Literacy Enrichment Afterschool Program）計畫，旨在促進兒童及青少年對閱讀的興趣、提供家庭作業指導，並透過讀寫活動與創客活動增進兒童及青少年的素養能力。

大部分公共圖書館並沒有如上所述的大規模課後輔導計畫可讓兒童幾乎每天參加。但在美國與英國大多數的公共圖書館都會設立家庭作業中心（homework center）或稱作家庭作業俱樂部（homework club），每週有固定時間提供服務，其主要目的為提供家庭作業指導（homework help），由輔導員（homework helper）協助兒童與青少年完成作業的要求，並藉由提供相關的書籍、參考工具書、主題資源資料庫等，提升兒童與青少年使用資訊的能力及培養終身學習的技能（周倩如，2006；Bevin & Goulding, 1999; Mcdermott, 2002; Mediavilla, 2001, 2003; Minkel, 2002）。除了家庭作業指導外，大多數英、美公共圖書館在平日的課後時間有安排各式各樣的活動，包括：手工藝、樂高（LEGO）、說故事及其他與STEAM教育相關的活動。

大部分公共圖書館課後輔導皆受到資金及人力的限制，因此需仰賴社區及外部機構的支持，建立合作關係，常見的合作機構為當地政府部門、學校、學校圖書館、教育機構、志工團體、其他社區團體或企業等（Cassell & Walther, 2006; Mediavilla, 2003; Train & Elkin, 2000）。在人員配置方面，多由支薪人員（館員或另聘一位負責人）管理課後輔導計畫，負責招募、訓練與安排輔導員（homework helper），因經費限制，輔導員通常是由志工擔任（Bevin & Goulding, 1999; Mediavilla, 2018）。為招募足夠的志工，許多圖書館會與當地中學或大學合作，學校有服務學習課程或實習課程，或學生本身有社區服務的需求，在合作上能達到雙贏（Huffman & Rua, 2008; Mediavilla, 2001, 2018），或到當地學區找現任或退休教師擔任輔導員（Mediavilla, 2018）。此外，圖書館也會與非營利

教育組織，尤其為學生提供課後輔導的機構（Hartman, 2011; Shaffer, 2006），或與志工團體合作（Cassell & Walther, 2006; Huffman & Rua, 2008），以獲得優秀的人力資源。

有關課後輔導對於兒童的影響，Train與Elkin（2000）對英國的八間圖書館進行個案研究，大量的質性資料證明家庭作業俱樂部確實為學生的課業提供了支持，能鼓勵兒童獨立學習，幫助兒童選擇最合適的資源，並學習利用資源。Huffman與Rua（2008）利用問卷與電話調查蒐集資料，詢問39位參與兒童的父母或監護人，以瞭解俄亥俄州楓樹高地圖書館家庭作業中心的有效性，研究結果顯示所有受訪者皆表示孩子更能理解作業，79%的受訪者表示孩子的成績有所提升，79%的受訪者表示孩子每天花時間完成作業。Bailey（1999）利用問卷、訪談與計畫文件蒐集資料，調查學生、老師及家長對於使用家庭作業中心對學業影響的看法，研究顯示參與後能有效完成作業，且參與次數越多的學生其作業完成率越高，受訪的學生也表示圖書館具有安靜且安全的學習空間、提供印刷資源與教育軟體及工作人員的幫助，使圖書館成為能有效完成作業的處所。羅素貞（2011）探討臺北市立圖書館曾實施的課後輔導「與閱讀做朋友：弱勢學童閱讀服務計畫」的成效，研究指出透過指導兒童作業，增加作業的完成度與正確性，無形中提高了兒童的自我肯定與成就感；且活潑的閱讀活動可提升學習意願低落兒童的參與興趣與學習動機。另有研究顯示兒童參與公共圖書館的課後輔導能提升兒童的學業成績（于錢寧娜，2005；Huffman & Rua, 2008; Mediavilla, 2001; Rua, 2008）、養成學習習慣（Mediavilla, 2001）、培養閱讀能力（Mediavilla, 2003），以及透過完成作業來獲得自信（Mediavilla, 2003）。除了獲得課業的幫助之外，研究顯示兒童與輔導員建立良好的情誼，有時也會就生活上的問題尋求建議，從中獲得鼓勵及情感上的支持（Mediavilla, 2001, 2018）。課後輔導讓兒童有機會與輔導員及其他學校的學生互動，從他人身上互相學習，透過與同儕及輔導員之間的正向互動，提升人際互動的技能（羅素貞，2011; Mediavilla, 2001, 2003）與自信（Mediavilla, 2001, 2003）。

㈢ 台灣課後輔導實施與影響

台灣為弱勢兒童規劃的課後輔導計畫，呈現方式有多種，主要是依據計畫目標而有所差異，且一項計畫可能會採用兩種以上的方式，大致分為以下四種方式：

1. 提供基本生活照顧與陪伴

主要以輔助家庭照顧功能為目的，有些機構會提供餐點，確保兒童的安全與生理需求，並給予兒童支持、陪伴與傾聽。時間的安排以陪伴與協助兒童順利完成作業為主（劉鎮寧，2013）。

2. 提供多元課外活動

提供課外活動的目的在於使弱勢兒童能獲得豐富的課外學習經驗。活動內容規劃則考量計畫目標、經費、人力、服務對象、場地等因素而有不同作法。常見的活動包含閱讀、影片欣賞、說故事、做美勞、團康活動、運動或其他才藝課程等，另外在寒暑假期間許多機構也會安排營隊、戶外教學等活動充實兒童的生活。有些機構也會根據計畫目標設計活動，將希望兒童學習的主題融入多元的活動中，使內容能兼具學習與娛樂的性質，讓兒童感到好玩、有趣（何俊青，2014）。

3. 提供課業輔導

課業輔導實施的內容著重在加強學校的學科教育，課後輔導人員除了指導兒童在學科作業中不會的地方，更針對學校課程的內容進行複習與教導。其中「補救教學」一詞為課業輔導中的一環，其目的在於降低弱勢兒童的學業成就落差，並提升其學習能力，因此需要專業教育人員帶領，必須瞭解學生的學習問題、思考解決辦法，並規劃有效的教學策略，以落實補救教學的目標（陳淑麗，2009；鄭勝耀，2013）。

4. 提供生活其他層面學習

主要以改善弱勢兒童的生活為目的，提升弱勢兒童在生活中的各項能力，通常會出現在基金會或社會福利機構辦理的課後輔導中。例如透過家事訓練加強生活技能，提升生活自理能力；運用自我管理、自我探索、情緒管理等課程，增進弱勢兒童的心理發展（謝依妏等，2017）。

弱勢家庭在生活上面臨著許多困境，例如：不穩定的生活、父母失業、單親、家庭生活環境差等，這些不利因素限制了家庭發揮正常功能，因而對兒童的成長發展產生不良的影響（陳雅鈴，2006；Conger et al., 2002）。除了家庭的不利因素外，在兒童成長的過程中，會面臨學習、人際關係、心理健康等問題，而這些問題皆是環環相扣、相互影響的。例如：弱勢家庭較難獲取足夠的教育資源及文化刺激，使兒童在學習上容易處於不利的情況，或因與同儕的生活視野落差，導致與同儕之間較少話題共通性，而容易被忽略、排擠或霸凌（王育敏、邱靖惠，2009）。學習及人際相處的問題，若沒有改善，長期下來容易使兒童產生情緒不穩定、自我概念低落等心理問題，或呈現不當的外在行為（李宜玫，2012；林士翔，2003；林俊瑩等，2012；邱瑜瑾、姜義雯，2010；Conger et al, 2002）。

綜合文獻歸納弱勢兒童經常在學習表現（陳淑麗，2009；Lacour & Tissington, 2011）、人際關係（王育敏、邱靖惠，2009；林士翔，2003）、行為表現（李介麟，2006；Dodge et al., 1994）及心理狀況（林俊瑩等，2012；邱瑜瑾、姜義雯，2010）方面遇到困難，過去研究也顯示課後輔導對於弱勢兒童在這四個層面的表現有正向幫助（參見表1）。

表1　台灣課後輔導計畫影響弱勢兒童四個層面

層面	對弱勢兒童之影響	文獻來源
學習表現	作業完成度提高、提升學習意願、學習態度較主動積極、學習興趣提升、養成讀書習慣	李孟峰、連廷嘉（2010）；湯維玲、蔡佩娟（2013）；顏國樑、宋美瑤（2013）
人際關係	學習適當社交行為及技巧、改善與同儕關係	孔詢媚（2019）；吳文炎（2015）
行為表現	改善問題行為、懂得守規矩、變得有禮貌、品行變好	洪清一（2011）；唐盈棣（2011）
心理狀況	提升自信、能肯定自我、提高自我要求	莊沛蓉（2019）；歐怡珍（2010）

雖然台灣其他為弱勢兒童辦理的課後輔導能為兒童帶來效益，但是台灣由公共圖書館自行辦理的課後輔導缺乏實證研究的探討。公共圖書館有別於其他政府機關、非營利組織，而且其在兒童的成長過程中一直以來扮演著支持兒童學習發展的角色，因此值得探討公共圖書館課後輔導為兒童帶來的影響。此外，從文獻中發現課後輔導對兒童的影響程度會因為課後輔導實施的方式、活動內容、兒童參與的感受等而有所不同，因此探討兒童參與的過程有助於瞭解課後輔導是如何為兒童帶來影響。

三、研究設計

㈠研究場域

為聚焦研究結果，本研究根據實施課後輔導服務的代表性、規模性與時間性，選擇新北市立圖書館作為研究場域。該研究場域自2013年開始實施課後輔導，為台灣第一個將兒童課後輔導納入常態性服務的公共圖書館（黃思維，2014），其服務對象為就讀國小一至六年級兒童，以弱勢兒童為優先參與對象。課後輔導由志工執行，圖書館稱之為「陪讀天使」，為兒童提供課業指導與陪伴閱讀，寒、暑假期間則會舉辦多元的活動。此外，服務提供弱勢兒童餐券，當天參與滿規定時數即可領取80元餐券，至指定便利商店兌換等值餐點。受到新型冠狀病毒肺炎（Covid-19）疫情影響，研究者資料蒐集期間許多圖書館參與陪讀的兒童人數皆降低，為確保能達到足夠的研究樣本數，研究者透過館方瞭解弱勢兒童參與情形，選擇參與人數較多的分館，同時考慮研究者的造訪次數及交通因素，最後選擇七間館舍作為研究場域。參與本研究的七間館舍皆位於交通便利的市區，其場域背景描述見表2。

㈡研究對象

本研究的研究對象為參與課後輔導的弱勢兒童、弱勢兒童家長、志工及館員，以立意取樣的方式進行選取。從四類不同的研究對象獲得不同角度的觀點，且能幫助交叉驗證，以獲得更全面性的研究資料。參與本研究之兒童總計22位、家長13位、志工八位及館員七位。

表2 研究場域背景描述

	A館	B館	C館	D館	E館	F館	G館
課後輔導服務起始年	2013	2013	2013	2013	2013	2016	2013
兒童區面積（平方公尺）	1,896.36	159.10	349.75	436.89	1,296.77	290.84	400.00
兒童圖書冊數（冊）	70,540	18,473	18,731	19,172	48,252	26,762	25,935
全年兒童推廣活動場次（場）	360	70	45	37	81	55	43
本研究進行資料蒐集時之志工參與情況	志工充足	非每日有志工	非每日有志工	無志工	志工充足	非每日有志工	無志工
課後輔導服務時間	週二至週五：晚上五點至八點 週三及週五：下午一點至五點 寒暑假：下午兩點至五點						

1. 弱勢兒童

本研究的取樣標準須符合以下兩條件：⑴符合領取餐券的資格（經圖書館認定為弱勢兒童者可領取餐券，包含低收入戶、中低收入戶、社會局轉介高風險家庭及身心障礙兒童）。⑵至少參與三個月以上。七間館舍總計有22位弱勢兒童參與研究，兒童的性別比例相近，年紀集中於高年級及中年級。兒童參與課後輔導的時間以兩年為最多，其次為三年以上及一年；參與頻率大多數為一週四天（參見表3）。

表3 參與研究之兒童背景資料

$N = 22$

		A館	B館	C館	D館	E館	F館	G館	總計
性別	男	4	2	2	1	0	1	0	10
	女	3	2	2	1	2	0	2	12
年級	低年級	1	0	0	0	0	0	0	1
	中年級	2	1	2	0	1	0	2	8
	高年級	4	3	2	2	1	1	0	13
參與課後輔導	3個月	2	0	0	0	0	0	0	2
	半年	0	0	1	0	0	0	1	2
	1年	0	1	0	2	0	0	1	4
	2年	2	3	1	0	1	1	0	8
	3年以上	3	0	2	0	1	0	0	6
一週參與天數	1天	0	0	1	0	0	0	0	1
	2天	0	0	1	0	0	0	0	1
	3天	1	0	2	0	0	0	0	3
	4天	6	4	0	2	2	1	2	17

2. 弱勢兒童家長

為兒童的父母或監護人。七間館舍中參與本研究的家長總計13位，皆為兒童的母親，年齡範圍分布多為40至49歲，教育程度分布則以大專／大學為最多（參見表4）。

表4　參與研究家長背景資料

N = 13

		A館	B館	C館	D館	E館	F館	G館	總計
家長身分	母親	3	2	3	1	1	1	2	13
年齡	30-39歲	1	0	0	0	0	1	1	3
	40-49歲	2	2	3	1	1	0	1	10
教育程度	國／初中	0	1	0	0	0	0	0	1
	高中／職	1	0	0	0	0	1	0	2
	大專／大學	2	1	2	1	1	0	2	9
	研究所以上	0	0	1	0	0	0	0	1

3. 志工

志工為課後輔導服務的執行者，負責陪伴及協助兒童完成作業、閱讀，並協助寒暑假多元活動順利進行。七間館舍總計八位志工參與本研究（參見表5）。

表5　參與研究志工背景資料

N = 8

		A館	B館	C館	E館	F館	總計
年齡	20-29歲	0	1	1	0	0	2
	40-49歲	3	0	1	1	1	6
教育程度	高中／職	1	0	0	0	0	1
	大專／大學	2	0	0	1	1	4
	研究所以上	0	1	2	0	0	3
課後輔導服務年資	1年以下	0	1	1	0	0	2
	1-3年	0	0	1	1	0	2
	4-6年	1	0	0	0	1	2
	7年	2	0	0	0	0	2
每週服務天數	1天	2	0	2	0	1	5
	2天	1	0	0	1	0	2
	3天（暑假）	0	1	0	0	0	1

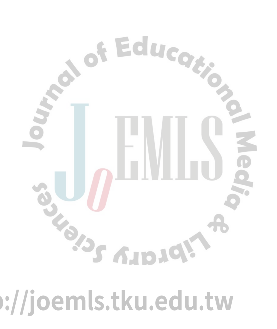
4. 館員

館員負責承辦課後輔導服務業務，包含安排陪讀志工、規劃寒暑假多元活動及管理陪讀服務。七間館舍各有一位館員參與研究，總計七位館員（參見表6）。

表6　參與研究館員背景資料

N = 7

館員背景資料		總計
年齡	30-39歲	2
	40-49歲	2
	50-59歲	2
	60歲以上	1
圖書館服務年資	未滿1年	1
	1-3年	1
	4-6年	2
	10-15年	2
	16-20年	1
課後輔導服務年資	未滿1年	2
	1-3年	3
	4-6年	2



㈢資料蒐集方法

1. 訪談法

本研究主要採用半結構式訪談法（semi-structured interview），訪談以一對一方式進行，以訪談大綱作為提問基礎，讓受訪者有回答問題的方向。訪談問題的編排原則為簡單至深入，由較容易回答的問題開始，逐漸引導受訪者回答需要更深入思考的問題。研究者在訪談開始前皆取得受訪者同意，清楚說明參與研究目的、過程與告知受訪者應有的權利。訪談過程使用錄音設備記錄，以利訪談結束後完整謄錄資料。

兒童訪談大綱的主要內容為詢問兒童參與課後輔導的原因、參與的活動內容、對自己的幫助。訪談時從較容易回答的問題開始發問，例如：「你為什麼會來參加課後陪讀？」、「你在課後陪讀的時間做了哪些事？」、「你喜歡參加課後陪讀嗎？」等問題，來瞭解兒童參與的活動內容和感受，逐漸深入至較需思考的問題，例如：「你覺得參加課後陪讀對你有什麼幫助？」，以瞭解活動對兒童的影響。家長訪談大綱的主要內容為詢問家長讓兒童參與課後輔導的原因、參與的活動內容、從家長角度瞭解兒童參與後的影響以及對於活動的想法與建議等問題。志工的訪談大綱內容主要為瞭解志工規劃課後輔導服務的方式與實際執行經驗、過程遇到的困難，同時從志工角度瞭解兒童參與後的影響。館員的訪談大綱內容主要瞭解課後輔導服務的目標與特色、館員對課後輔導服務的規劃、過程遇到的困難，以及從館員的角度瞭解兒童參與後的影響。

2. 觀察法

本研究亦採用直接觀察法，第一作者實際到研究場域觀察研究對象在課後輔導活動中產生的行為，在觀察過程中不介入活動，以局外人角度觀察與記錄。本研究的觀察紀錄表主要內容為觀察兒童參與課後輔導的過程，包含出現在課後輔導場域的兒童、家長、志工與館員在活動的過程做了什麼事，以及兒童與家長、志工及館員之間的互動與對話，以瞭解課後輔導如何為弱勢兒童帶來影響。

㈣資料分析

基於遵守研究倫理，本研究將研究對象以匿名方式編碼：兒童代號為C（Children）、家長代號為P（Parent）、志工代號為V（Volunteer）、館員代號為L（Librarian），並將參與本研究之七間館舍以A至G表示，如：O-A1表示研究者第一次到訪A館觀察課後輔導活動的過程。本研究參考Braun與Clarke（2006）提出的主題分析法（thematic analysis）之步驟整理與分析訪談資料。研究者首先將所蒐集的資料進行謄錄與整理，並反覆閱讀資料內容，接著進行初始編碼，將與研究問題相關的重要對話片段擷取出來。研究者設定訪談紀錄編碼方

式為「訪談逐字稿-研究對象編碼-頁數:行數」，呈現方式為「I-C1-1:10」；觀察紀錄編碼方式為「觀察紀錄表-課後輔導活動編碼-研究對象編碼」，呈現方式為「O-A1-C1」。

接著將編碼資料中相似的內容歸納為同一主題，同一主題下再細分成次主題，如：大主題為「對兒童的影響」，再歸納出次主題為「培養閱讀習慣」、「提升閱讀興趣」、「學業表現進步」等，並反覆檢視初步分類後主題的邏輯性，檢視的方式分為兩個層面，一為確認主題與對話片段的涵義是否具有一致性，二為確認主題內的同質性與主題間的異質性。例如在「對兒童的影響」的次主題裡，研究者發現「閱讀速度提升」與「增進寫作能力」的編碼內容皆為透過閱讀而幫助學業的發展，因此將此兩處的次主題合併歸納至「學業表現進步」此主題之下。

研究者在確定主題後，給予各個主題明確的定義，並確認主題名稱所使用字詞是否適當，以「對兒童的影響」為例，此主題的定義為「公共圖書館課後輔導服務對兒童的學習表現、人際關係、行為表現與心理狀況的影響」。

㈤研究信度與效度

本研究使用錄音設備記錄訪談的過程，並觀察與記錄研究對象在口語表達之外的肢體語言（如表情、動作），訪談結束後將錄音檔轉換成逐字稿，以確保研究的效度。本研究使用三角檢驗法（triangulation），透過兒童、家長、志工與館員四類不同研究對象的角度來交叉檢核資料的正確性，並以訪談法及觀察法兩種不同研究方法檢視訪談內容與實際觀察情形之相符程度。此外，本研究使用一致的研究實施方式，對每位研究對象皆採用相同的訪談程序，透過事先擬定的訪談大綱進行訪問，避免因不同受訪者而影響取得資料的差異性。

四、研究結果

㈠家長對兒童參與公共圖書館課後輔導原因

本研究歸納家長對兒童參與公共圖書館課後輔導的原因，主要包括：家長缺乏時間陪伴、家庭學習環境不佳、課業的需求、餐券的誘因。

1. 家長缺乏陪伴時間

公共圖書館的夜間服務，提供晚上需要工作而無法照顧兒童的家長一個安置的處所：

> 之前有在上班，所以沒有辦法照顧，學校的課後班沒有到那麼晚，所以圖書館剛好開辦這個陪讀的活動，所以就讓她參加。（I-P12-1:5）

除了提供安置兒童的場所之外，圖書館更希望兒童在這段時間能獲得陪伴，因此課後輔導服務招募志工陪伴兒童，以彌補家庭功能的缺失。許多家長都認為圖書館是個能使他們感到安心的地方，也肯定志工和館員的照顧與陪伴：

我還蠻放心她在這邊的，因為有時候有志工嘛，然後（館員）阿姨會幫忙看著，就是我稍微可以放心地去工作一兩個小時這樣，這對我來說有蠻大的後援支柱的感覺。（I-P8-4:7，括號為研究者所加）

2. 家庭學習環境不佳

對於家裡空間不足、缺乏學習資源的家庭而言，圖書館提供良好的學習環境與豐富的資源，以輔助兒童的學習需求，有些家長表示：

因為我們租的房子比較小，所以我們通常都是在外面，之前他比較小的時候靜不下來的時候，我兒子就跟我女兒然後會去便利商店，然後後來是到圖書館，這邊的空間比較大，而且比較適合讀書跟學習。（I-P11-1:5）

有些家長表示雖然家中有其他家人幫忙照顧兒童，但兒童在家裡無法專心在課業上，因此希望兒童能多多接觸圖書館，感染讀書的氛圍，進而增加兒童閱讀的機會。

3. 課業的需求

有些家長表示讓兒童來參加圖書館課後輔導，主要是因為有志工可以詢問課業上的問題，同時可減輕補習的經濟負擔：

因為我們經濟也有限，啊所以就是說啊有些那個我不太會的部分，要請那個陪讀的……志工姐姐教導他們一下，啊他們的課業就是會比較好一點。（I-P4-1:5）

有些新住民家長，礙於語言問題，缺乏協助兒童課業的能力：

我不是本地人，啊所以就是說有些我不懂的齁，可以詢問到陪讀的姐姐，這樣子解決到我的困難啦齁。（I-P4-3:30）

來自隔代教養家庭的兒童，其祖父、祖母亦缺乏協助兒童課業問題的能力，因此需要陪讀志工的協助：

比如說隔代教養，然後有時候阿公、阿嬤沒有辦法陪伴他做課業上的一些學習，或是閱讀之類的。（I-L3-1:6）

此外，因為有些志工是退休老師，具有教學的經驗與專業，在課業上較能夠引導兒童，也是吸引家長讓兒童參加的原因。

4. 餐券的誘因

餐券對於弱勢家庭的經濟補貼是最實質的幫助，同時也希望透過餐券的補助讓弱勢兒童多接觸圖書館。有些家長表示因受到餐券的吸引讓兒童參加課後輔導服務，館員也觀察到餐券確實是很大的誘因：

有些弱勢生他們有時候真的學校功課都完成了，啊就是因為晚上來閱讀一個小時的話他們就可以拿禮券，所以他們就會來這邊再看書一個小時這樣子。（I-L3-5:8）

㈡ 兒童參與公共圖書館課後輔導活動內容

因各館陪讀志工的人數不一，且志工來源多元，志工的服務方式也呈現多元面貌，因此，兒童參加課後輔導的活動內容也多元，以下分平日放學後及寒暑假說明如下：

1. 平日放學後

⑴ 寫作業

兒童參加課後輔導，大部分的活動都在寫作業，兒童在寫作業時遇到不會的地方可立即詢問志工，以獲得解答。但是館員觀察到有些兒童不會主動向志工詢問課業問題。多數兒童表示寫完作業後，志工老師會幫忙檢查作業，訂正作業的錯誤並給予指導，也有兒童表示志工不會幫忙檢查作業。

本研究發現兒童在寫作業的過程，經常運用的館藏資源是字典。許多志工會引導兒童多運用圖書館的書籍作為參考資源，以解決課業上的問題：

> 有很多百科或是專門的題目的一些書籍，那他們在作業上偶爾會碰到這些東西，那就要帶他們說去哪邊找資料，阿找出來再從資料裡面去搜尋，或他們自己去拿出他們需要看的一些項目，他們可以從這些項目裡面來取捨。（I-V5-2:8）

> 圖書館就是書非常的多，那書也是多方面很多類型都有，那像我上次指導那個他是找音樂類型的書，對，所以我覺得有在圖書館這個場地其實也還不錯，就資源很多這樣。（I-V4-2:12）

⑵ 閱讀

參與本研究的大多數兒童放學後都有參加學校的課後輔導班，而課後輔導班也是以寫作業為主，因此有些兒童在學校課後輔導班就已經完成作業，若在學校寫不完，則會在圖書館陪讀時繼續將作業完成。兒童完成作業之後的時間，志工通常會鼓勵兒童自行閱讀，兒童也逐漸養成寫完功課就去閱讀的習慣。在課後輔導時兒童可以自由選擇想閱讀的書，研究結果發現許多兒童喜歡看漫畫，一進到圖書館會直接去尋找漫畫來看（O-A3-C1、O-A4-C2、O-B2-C9、O-C3-C14、O-E2-C18）。除了自行閱讀之外，有些兒童會和志工共讀，並討論書籍裡的內容（O-A4-C2）。有些兒童閱讀志工推薦的書籍後，會和志工分享心得。年紀較小的兒童會聽志工說故事：「比較小就傾向於唸故事給他聽，就等於說有一點說因為一年級他們也沒什麼功課。」（I-L6-1:11）。

⑶ 課業輔導

在學校考試前，有些兒童在志工教導下，複習考試內容。有些兒童有其他課業想加強學習的需求，因此尋求志工協助，如家長P4提到兒童C9在學校電腦課操作比較慢，跟不上同學，加上家裡的電腦壞了，正好可以利用圖書館的電腦來練習：「因為他電腦操作也是完全都不行，家裡的電腦也是壞掉了，所

以就是換來這邊」(I-P4-2:21),因此兒童C9運用暑假期間加強平日上課不會的科目,志工帶著兒童C9練習學校電腦課的上課內容,一步一步地教導兒童C9操作Word流程圖(O-B3-C9):

V3:C9,你想要練習什麼?
C9:這個,流程圖。
V3:好啊,那我們用這本書來練習〔手指著兒童手中的書〕。
C9:我喜歡這本書〔笑〕。
V3:〔笑〕你看書裡面出現過什麼角色,誰先出現?
C9:第一個是尼尼。
V3:好,打在框框裡,接下來是誰呢?(O-B3-C9,括號為研究者所加)

⑷ 美勞

有些兒童因為個人興趣,會在課後輔導時進行美勞活動:「有時候就是跟同學跟我朋友畫畫」(I-C22-1:5)。有些志工偶爾會準備一些手作活動與兒童一起動手做:「有時候我會陪他們做一些摺紙啊,或者一些小小的DIY的創作這樣子。」(I-V6-1:24);「還有做美勞、剪紙啊,低年級會帶他們做,高年級就比較沒時間,功課比較多」(I-V8-2:25)。

⑸ 遊戲

部分兒童表示會和其他參與陪讀的兒童一起玩遊戲、聊天。此外,有的館舍有提供玩具館藏,兒童會和朋友一起玩玩具:「玩比如說這裡的大富翁,或是一些煮菜的遊戲」(I-C14-2:21),或有的館舍位於公園旁,志工會帶所有參與陪讀的兒童去公園動一動,也藉機讓兒童之間互相交流。

2. 寒、暑假多元活動

寒、暑假的陪讀服務時間不固定,暑假安排約二至四週的活動,時間為下午兩點至五點,前兩個小時為多元活動,後一個小時為寫寒、暑假作業時間。2020年暑假的陪讀活動主題是「AI在陪讀」,配合108課綱將人工智慧納入教材,圖書館以此為主題規劃相關的活動。兒童參與的活動內容包含DIY及桌遊等,透過活潑有趣的方式,讓兒童接觸到科學知識與程式設計的概念:「在做那個就是……就是把它裝成一台車它就會跑」(I-C13-2:23);「做機器人,或是做一個彈珠的雲霄飛車」(I-C14-1:34)。家長認為當年的活動較為特別,對於活動內容表示肯定:「他比較有興趣就是電腦類的,像這次的AI他就非常有興趣」(I-P6-1:25);

往年暑假可能做的DIY做的東西比較簡單,今年暑假比較有……有那個……比較特別、比較有意思。(I-P10-2:2)

除了與科學、科技相關的活動之外,圖書館課後輔導每年寒、暑假舉辦的活動內容多元,包含繪本故事、電影欣賞及手作課程等。兒童表示喜歡的活動包含電影欣賞:「我喜歡星期五歡樂電影,看電影」(I-C6-1:25)、手作課程:

「畫畫」（I-C11-2:3）、「做黏土」（I-C17-1:27），以及自然科學課程：「昆蟲課」（I-C16-1:16）。

㈢公共圖書館課後輔導對兒童的影響

兒童參與課後輔導之後，大多數兒童的感受都是正面的，其正面的感受來自於閱讀的樂趣，或喜歡參加寒暑假多元活動。本研究歸納弱勢兒童參與課後輔導之後產生的影響，包含：培養閱讀習慣、提升閱讀興趣、學業表現進步、拓展學習視野、增進人際互動、習得禮儀、提升心理狀態。

1. 培養閱讀習慣

兒童在參與課後輔導之後閱讀量明顯增多。陪讀活動並沒有規定兒童一定要閱讀，但館員和家長都認為因為館內圖書資源豐富，促使兒童接觸書籍，進而主動閱讀：「他在這邊就是可能是環境的關係吧，就是他自己會去拿書來看，會找自己想看的書」（I-P11-2:12），另外，有些家長認為圖書館的環境能讓兒童閱讀的專注力提升，長期下來能增進閱讀的時間：「好像這個空間可以讓他們去把一本書讀完，好像就是可以比較靜下來讀啊」（I-P3-3:25）。本研究大部分的兒童一週參與四天陪讀活動，兒童和家長都表示透過長時間參與能逐漸培養出閱讀的習慣。

2. 提升閱讀興趣

因為在圖書館能自由閱讀，兒童可以找自己有興趣的書，進而對閱讀產生興趣，兒童和家長表示參與陪讀之後對閱讀更有興趣，因為喜愛閱讀，使得兒童在空閒時會主動拿起書閱讀，也降低對3C產品的慾望和使用：

> 他們會拿一些書自己看，打發時間，然後我也可以做我自己的事情，因為其實也比較不會一直吵著說想要使用一些3C產品，因為我們家本來就沒有電視，就是他們會比較願意去閱讀一些書。（I-P2-4:25）

3. 學業表現進步

志工的指導使兒童能更快完成作業：「因為本來就覺得寫作業就是要花很久的時間，可是在這裡陪讀都有阿姨會細心地教」（I-C14-2:29）。許多志工通常都會幫忙檢查作業，兒童的作業錯誤率因此降低：「在這裡寫功課有志工檢查比較不會錯」（I-C15-2:26），且因為有陪讀志工的指導，兒童的成績有所提升：「爺爺有跟我說我的成績有進步」（I-C15-2:28），因而自信心提升（I-C8-3:14）。此外，有些兒童表示閱讀量增多之後，能夠提升閱讀速度，或有助於增進寫作的能力，進而提升課業表現。

4. 拓展學習視野

圖書館擁有豐富的圖書資源，能夠作為學校課堂之外的補充學習，而課外的學習或許會對兒童有潛移默化的幫助：

> 這邊就有一個好處就是書很多，而且是不管什麼樣的書，漫畫書也好啦，一些那個摺紙啦一些DIY的書，或者是一些比較藝術性的書，他們就是會拿來看，我是覺得無形中會有一些……對他們有一些潛移默化的幫助啦（I-V6-2:16）

兒童與家長都表示透過大量及多元閱讀能獲得課外知識：

> 可以學習到學校以外的知識，因為其實學校教的就是制定的，那像哥哥他就會知道一些比較冷門的知識。（I-P2-3:24）

家長也提到讓兒童選擇他喜愛的、有興趣的書籍，兒童能在無形中吸收許多知識，且對於新的知識較感興趣。此外，兒童與家長表示暑假的多元活動讓兒童原本的空閒時間更充實，同時也透過活動增加兒童接觸新事物的機會：「我覺得（活動）很多樣化，對，而且她平常也蠻少接觸這類的東西」（I-P13-1:31，括號為研究者所加）。館員發現藉由接觸各式各樣的活動，兒童可以從中找到自己的長處：「在圖書館的一些活動你可以看到他有發揮的機會」（I-L1-10:23）。

5. 增進人際互動

在平日放學後，圖書館成為兒童與同儕、志工及館員交流、互動的場域。有些兒童表示在陪讀的活動中交到了好朋友：「在這裡就是會交到比較多朋友」（I-C14-2:34）。家長觀察到兒童參與久了之後會提升社交能力，主要是透過閱讀獲得與人互動時的討論話題：

> 比較會懂得講一些小故事給人家聽啊，或講一些笑話逗人家笑這樣，就是人際會好一點，因為就有一些話題。（I-P2-4:2）

透過課後輔導，家長與館員之間也建立起良好的情誼，館員L1和弱勢兒童家長創了一個LINE的群組，方便館員發布訊息，也促進家長之間的交流。研究者也觀察到館員L1下班之前，到陪讀區域和家長P1聊兒童的近況（O-A3-L1）。

6. 習得禮儀

參與課後輔導有助於少數兒童習得禮儀，一位館員陳述兒童C2過去的行為，對比現今行為穩定，並且主動閱讀，可以明顯看見兒童的成長：

> （改變）最大就C2啊，一、二年級〔嘆氣〕那真的是一進來就把衣服就丟了，先脫外套、丟書包、丟鞋、丟便當，反正就是滿地丟這樣子，以前也會耍脾氣，可能不合他意或什麼的話，他就會很大聲，或者是剛開始看書的時候他也不會去珍惜那個書。（I-L1-9:19，括號為研究者所加）

館員表示有些弱勢兒童的家長平時可能較忙而疏於管教，在課後輔導有志工會幫忙矯正兒童不好的行為，或是因為圖書館的環境使得在館內的大人都會提醒兒童要遵守規矩，而行為的正向改變不僅僅是對兒童的幫助，也是對整個家庭的幫助。

7. 提升心理狀態

多數兒童皆表示參加課後輔導之後變得比較快樂、自在，因課後輔導的實施方式較為自由，其氛圍讓兒童感到較為放鬆、自在：「跟平常義務教育比，圖書館比較放鬆、自在」（I-P1-3:33）。有些家長表示因為兒童喜歡閱讀，閱讀本身就是兒童放鬆與紓壓的方式，因此來圖書館感到很開心、自在。其中兒童C2的感受最為明顯，他覺得來圖書館比較自在、沒有壓力，也變得比較快樂：「在學校有人會欺負我，在這裡沒人會欺負我〔激動〕」（I-C2-2:18，括號為研究者所加），在圖書館陪讀有志工陪伴與傾聽，志工V8退休前在補教業當老師，比較懂得如何教育兒童以及和兒童相處，長期下來兒童已對她產生了信任感，兒童C2特別會和她說在學校遇到的困難：

> C2他說在學校被說很臭，臭是還好我沒聞到，但是頭髮太髒，我就跟他說他就能接受，他這樣講我今天就帶了一塊肥皂要給他〔笑〕。（I-V8-3:28，括號為研究者所加）

館員也表示圖書館提供家庭和學校之外的環境陪伴兒童，志工提供兒童傾訴煩惱與情緒的管道，在兒童生活中遇到難題時給予開導以及心理支持，對於兒童的心理發展有很大的影響。

五、討　論

㈠ 家長對兒童參與公共圖書館課後輔導的原因

本研究結果呼應了Dowd（1989）的公共圖書館與鑰匙兒童問題之研究，大部分家長認為圖書館是一個安全的地方，而且有人陪伴，將小孩安置在圖書館能使他們感到放心。此外，本研究結果顯示有些家長會到館陪伴兒童，其參與課後輔導的主因為家中缺乏學習的環境（包括：家裡空間太小、缺乏學習的氛圍、缺乏與同儕互動的機會等），以及課業上缺乏指導。類似的，Bailey（1999）、Mediavilla（2001, 2003）、Train與Elkin（2000）亦談到對於家裡缺乏書籍、資訊通信技術設備、合適的學習空間的學生，或是不瞭解孩子的作業、缺乏語言技能的父母而言，公共圖書館的家庭作業中心尤其重要。有別於英國和美國大部分公共圖書館課後輔導所提供的服務。本研究的案例提供弱勢兒童餐券，其為兒童參與課後輔導的原因之一，可以得知餐券對於弱勢家庭經濟上的支持能夠吸引他們前來參加。

㈡ 兒童參與公共圖書館課後輔導的活動內容

文獻指出，台灣非營利組織及政府為弱勢兒童提供的課後輔導實施方式主要包括：提供基本生活照顧與陪伴、多元課外活動、課業輔導、生活中其他層面的學習（何俊青，2014；陳淑麗，2009；鄭勝耀，2013；謝依妏等，

2017）。本研究結果顯示兒童參與的公共圖書館課後輔導的活動內容著重於陪伴、寫作業、閱讀及寒暑假的多元活動。公共圖書館課後輔導與其他課後輔導的差異與特色為公共圖書館擁有豐富的館藏與學習環境，有助於兒童獲取學習資源。雖然課後輔導服務的目標不在於加強學科教育，以降低學業成就落差，僅針對作業的問題提供協助，但本研究發現部分志工為退休老師，會以自身的專業科目為兒童進行課業輔導。

本研究發現志工在協助作業時有各自的服務方式，有些志工態度積極，會主動關心兒童、詢問兒童有無作業問題、幫忙檢查作業，而有些志工則較為被動，等待有課業問題的兒童自行詢問，較傾向駐點學科指導人員。陳怡文與林麗娟（2014）指出志工必須主動與兒童進行互動、拉近彼此距離，雙方有良好的互動基礎後能使輔導過程更為順利。建議圖書館辦理志工訓練，使志工學習課後輔導相關的知能，並建立良好的服務態度，以提升服務品質。

相較於英國與美國的公共圖書館在平日放學後規劃較多團體活動，本研究發現參與的兒童平日到館的時間不同，或是兒童作業量不一，因此課後輔導多以一對一方式進行。團體活動於寒、暑假舉行較為適合。

㈢公共圖書館課後輔導對兒童的影響

過去文獻顯示，台灣的課後輔導對弱勢兒童有正向幫助，其影響包括：學習表現（李孟峰、連廷嘉，2010；湯維玲、蔡佩娟，2013；顏國樑、宋美瑤，2013）、人際關係（孔詢媚，2019；吳文炎，2015）、行為表現（洪清一，2011；唐盈棣，2011）及心理狀況（莊沛蓉，2019；歐怡珍，2010）四個層面。本研究亦見證公共圖書館課後輔導對兒童的影響在這四個層面皆有幫助。其中影響最大的為學習層面，包括培養閱讀習慣、提升閱讀興趣、學業表現進步與拓展學習視野。

過去研究顯示，公共圖書館課後輔導對兒童學習表現的影響不外乎是作業完成度提高、錯誤減少、成績進步等（于錢寧娜，2005；Huffman & Rua, 2008; Mediavilla, 2001; Rua, 2008）。本研究也有相同的發現，但人數並不多，可能是因為圖書館課後輔導的實施方式並不是系統性的教學。此外，多數參與圖書館課後輔導的兒童亦有參與學校的課後輔導班，難以判定作業與成績的進步是否為圖書館課後輔導帶來的影響。

本研究的實施場域在圖書館，在學習方面最大的影響顯現在閱讀上，圖書館的環境提高兒童接觸書籍的機會，固定的陪讀時間使兒童逐漸培養出閱讀習慣，自由選擇喜歡的書籍促使兒童體會到閱讀的樂趣。此外，參與課後輔導亦有助於兒童拓展學習視野的機會。本研究發現圖書館提供的活動是許多弱勢兒童（尤其獲取資訊的能力與管道較為缺乏的家庭），寒暑假期間唯一參與的活動，如過去研究指出弱勢兒童可獲得的文化資本較少，導致文化刺激不足（王

育敏、邱靖惠，2009；林信志、簡瑋成，2019；Lacour & Tissington, 2011），因此寒暑假期間圖書館的活動對於弱勢家庭而言更顯重要，使兒童能藉此接觸新事物、體驗多元的主題課程。公共圖書館課後輔導或許對於學校課業表現的幫助較小，但圖書館的資源有助於補充課堂之外的學習，同時彌補弱勢兒童的學習落差。

在人際關係方面，研究結果發現少部分兒童透過閱讀學習到一些知識、小故事等，在與人互動時能夠分享、開啟話題，有助於社交能力的提升。兒童在課後輔導認識了不同的朋友，接觸到不同年齡層的志工及館員，增加了兒童與人互動、交流的機會。Aabø等（2010）提到公共圖書館是一個聚會的場所（a meeting place）。本研究也觀察到不僅是兒童，家長和館員之間也建立起良好的情誼。本研究結果顯示部分分館因參與人數較少、參與兒童年紀差距大、兒童到館時間不一，而缺乏同儕之間的互動。有些分館因缺乏志工或志工態度較為被動，也是影響人際互動的原因之一。

在行為表現上，參與圖書館課後輔導對少數原本行為表現不佳的兒童有顯著影響，圖書館的環境有助於兒童學習遵守規範，加上志工與館員的糾正與管教，使兒童漸漸能注意禮儀。

在心理層面的影響，兒童認為參與課後輔導感到較為自在，因圖書館課後輔導的實施方式較為自由，兒童能自在、放鬆地做自己感興趣的事情。本研究發現一位參與兒童會和志工傾訴生活中遇到的困難與煩惱，由於志工的關心及傾聽使兒童感到被支持，也較為快樂，可以發現志工用心與兒童建立良好的關係對於兒童的心理健康發展產生莫大的效益。類似的，Mediavilla（2018）的研究亦發現若志工與兒童培養良好的關係，公共圖書館課後輔導不只是提供課業支持，兒童能與志工分享生活中的問題，並獲得情感上的支持。

六、結論與建議

本研究以實證研究彰顯公共圖書館透過實施課後輔導支持社會正義的價值。研究結果反映公共圖書館課後輔導有助於彌補弱勢兒童的資訊落差與學習落差，其影響層面包含：培養閱讀習慣、提升閱讀興趣、學業表現進步、拓展學習視野、增進人際互動、習得禮儀及提升心理狀態。此外，本研究揭示參與者（兒童、家長、志工）對公共圖書館課後輔導的回饋，可供圖書館參考，以更瞭解使用者的看法，進而提供更符合使用者需求的相關服務。

根據受訪家長的回饋，家長希望志工能更主動陪伴兒童。基於圖書館的特色，本研究建議圖書館增加陪讀活動的多樣性，例如：為低年級兒童說故事、中高年級兒童進行有趣的閱讀挑戰（闖關、學習單等），由志工引導兒童參與，讓陪讀不僅能鼓勵兒童獨自閱讀，更能透過遊戲方式讓兒童與志工及同儕產生

更多互動，藉此增添閱讀樂趣。此外，為增加陪讀活動效益，建議圖書館辦理志工訓練，加強志工帶領兒童進行閱讀活動的技巧。

以本研究為基礎，建議未來研究進一步探討偏鄉圖書館的課後輔導服務成效，並與市區圖書館的課後輔導服務成效進行比較分析。此外，在疫情期間，圖書館資源對弱勢家庭更顯重要，目前公共圖書館課後輔導服務的對象為所有兒童（包括一般兒童和弱勢兒童），建議未來研究探究來自不同家庭背景的兒童對於課後輔導服務的看法與影響，以獲得更全面的研究結果。最後，未來研究可採用行動研究，由學者和實務者合作，針對實務上的問題，一同發展解決的策略，並實際落實與評估成效。

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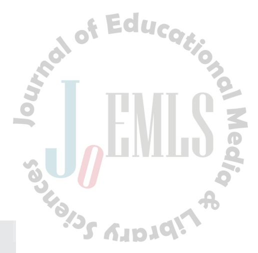
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Journal of Educational Media & Library Sciences 59 : 2 (2022) : 137-168
DOI:10.6120/JoEMLS.202207_59(2).0010.RS.AM



Effects of Afterschool Programs in Public Libraries on Disadvantaged Children: The Case of the New Taipei City Library[ψ]

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Abstract

This study aims to investigate effects of afterschool programs in public libraries on disadvantaged children in Taiwan, which serves to demonstrate the value of public libraries for supporting social justice. This study was qualitative in nature. Interviews and observations were employed for data collection. Study participants included: 22 children, 13 parents, eight volunteers, and seven librarians. Findings of this study show that the reasons for parents allowing their children to participate in the program were a lack of time to take care of their children, an inadequate home learning environment, their children requiring assistance needed for to complete their schoolwork, and the meal voucher incentives. In addition, the main activities the children participated in in the public library afterschool programs were finishing their homework and independent reading; other activities, such as reading together, receiving help with their homework, art projects, and games, were arranged by volunteers. Finally, the effects of these programs were improvements in relation to reading habits, reading interests, academic progress, learning vision, interpersonal relationships, etiquette, and mental health.

***Keywords**: Public libraries, Afterschool programs, Disadvantaged children, Qualitative research*

SUMMARY

Introduction

Afterschool programs assist parents in caring for and teaching children,

[ψ] This article was adapted from a master's thesis under Ya-Wei Chuang "Effects of Afterschool Programs in Public Libraries on Disadvantaged Children: A Case of New Taipei City Library".

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Please visit JoEMLS website to read the Peer Review Report (Open Point) and Article Summary (InSight Point) of the article.
2022/04/13 received; 2022/06/20 revised; 2022/07/05 accepted

alleviate children safety concerns after school, and support children's physical and mental development. Time arrangement after school is associated with children's growth. The informal learning process is one of the influential factors in creating children's achievement gap, apart from the formal school learning (Hartman, 2011). Nevertheless, insufficient resources among disadvantaged families make it difficult for some children to receive additional learning opportunities. These families are consequently more dependent on support from social institutions.

Social justice is a core public library mission (Pateman & Vincent, 2010). Public libraries provide free and equal access to afterschool programs for children who need the services to support their learning and development process. For children in comparatively disadvantaged economic and social areas, or those from schools and families which lack learning related resources, afterschool programs are particularly necessary with a view to compensating for the gap in education resources (Bevin & Goulding, 1999; Bundy, 2006). Previous studies have also shown how public libraries' afterschool programs could positively influence children (Bailey,1999; Huffman & Rua, 2008; Train & Elkin, 2000).

New Taipei City Library is the first public library in Taiwan that incorporates afterschool programs to its regular services (S.-W. Huang, 2014), where services for disadvantaged primary school children are prioritized. Afterschool programs are executed by volunteers to provide homework help as well as reading companionship for children; diverse activities are designed and carried out during winter and summer vacations. Other than that, meal vouchers are distributed to disadvantaged children upon fulfilling the required time of participation. This study takes New Taipei City Library as an example to explore the effects of afterschool programs in public libraries on disadvantaged children.

Methodology

This was a qualitative study, where interviews served as a primary data collection method and observations as a subsidiary one. This study chose seven branch libraries of New Taipei City Library as the research settings based on their nature in representation, scale, and time length of offering afterschool programs. Study participants involved 22 children from disadvantaged families, 13 parents from disadvantaged families, eight volunteers, and seven librarians who participated in the afterschool program. This study adopted thematic analysis for analyzing the data gathered, with a focus on reasons why parents let children participate in the program, what activities children participated in, as well as what effects the programs had on children involved.

Results and Discussion

The result has shown that the reasons for parents allowing their children

to participate in the program included: lack of time to accompany children, inadequate learning environment at home, assistance needed for completion of schoolwork, and the incentives of meal vouchers. Different from previous research, this study found that meal vouchers served as a strong incentive for parents to let children participate in the program.

Main activities in the public library afterschool programs in which children participated were finishing homework and independent reading; other activities were arranged by volunteers, such as reading together, homework help, artwork, and games. The result has shown the effects of such programs on children, including: cultivation of reading habits, development of reading interests, progress in academic performance, enhancement of learning vision, boost in interpersonal relationships, etiquette acquisition, as well as improvement in mental state.

Two of the most significant effects are of the reading and learning perspectives. The library environment has increased children's exposure to books. The regular reading together time has helped children gradually develop their reading habits, and they had experienced the fun in reading as they were able to choose books to their preference. This study has found that activities provided by public libraries were the only activities in which many disadvantaged children (especially those from families lacking in skills and channels of information acquisition) participate during winter and summer vacations. Children broadened their learning vision as they read and participated in various activities, in which they gained more new experiences and learned more diversly in numerous theme activities.

Conclusion

This study explored the practical operation of afterschool programs in public libraries and the effects of such programs on children involved, in hope of filling the research gap in this field. The results derived from this study have demonstrated how public libraries fulfilled the social justice mission through executing afterschool programs. These programs have brought about positive effects in closing the information gap and learning gap of disadvantaged children in the following aspects: cultivation of reading habits, development of reading interests, progress in academic performance, enhancement of learning vision, boost in interpersonal relationships, etiquette acquisition, as well as improvement in mental state.

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Journal of Educational Media & Library Sciences
JOEMLS

教育資料與圖書館學　59 : 2 (2022) : 169-199
DOI:10.6120/JoEMLS.202207_59(2).0012.RS.AM



研究論文

從出版特徵與引用影響指標探討開放取用期刊文章處理費：以醫學領域為例[ψ]

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摘要

OA期刊複雜的APC運作機制，隨著OA期刊的發展逐漸受到學術界的重視。本研究以JCR-SCIE 2017年版收錄的47個醫學次領域為範圍，在扣除重複後，為使資料具合理性，僅以收取固定APC的2,037種期刊為對象，探討出版特徵和引用影響指標與APC機制之關聯性。研究結果顯示，APC金額與刊齡於統計學上並無呈現顯著的相關性，與出版頻率及OA文章數則分別呈現低度正相關與低度負相關，顯示APC金額可能會受其差異所影響。在期刊引用影響指標方面，APC金額與期刊IF和II值皆具有相關性，學科排名則僅在Q1和Q4區間內具有顯著性，表示排名越好的期刊APC收取金額可能越高，而排名較差的期刊APC金額可能相對較低。建議未來可採用問卷或訪談方式瞭解作者投稿OA期刊的動機及支付APC的意願。

關鍵詞： 開放取用，文章處理費，期刊出版特徵，影響係數，期刊排名，立即指數

前　言

近年以開放取用（open access，簡稱OA）模式出版的期刊數逐漸增加，該出版機制被視為能有效解決期刊危機的一種方式，但其複雜的運作與部分OA期刊收取高額出版費用的做法，也開始受到學術社群的關注及討論。

ψ 本文改寫自林家鈺之碩士學位論文「從開放取用期刊出版特徵與影響力視角探討醫學領域期刊文章處理費之研究」，最原始的研究議題則由其指導教授林雯瑤所啟發。

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此篇文章之同儕評閱意見報告（Open Point）及導讀簡報（InSight Point）請至本刊網站查閱
2022/04/24投稿；2022/07/13修訂；2022/07/30接受

有別於以往使用者付費取閱（toll access，簡稱TA）的出版模式，OA出版成本由作者或其所屬機構支付，這種收取文章處理費（article processing charge，簡稱APC）的付費機制可能會為作者帶來沉重的負擔（Nelson & Eggett, 2017; Sotudeh & Ghasempour, 2018），如何為研究者提供有效支持支付APC資金的來源，亦為學術界將面對的課題。

若探討APC的收費價格，多數研究表明大型商業出版公司收取金額明顯高於其他類型之出版單位，其中又以複合式（hybrid）OA期刊APC金額更高（Jahn & Tullney, 2016; Kingsley, 2014; Pinfield et al., 2016; Siler et al., 2018; Smith et al., 2017; Solomon & Björk, 2012a, 2012b），但複合式OA期刊這種部分文章保留傳統收取訂閱費的作法，以致質疑出版商雙重收費的聲音亦隨之而起（Björk & Solomon, 2014; Schimmer et al., 2015; Smith et al., 2017）。

APC機制可視為支持OA出版與運作的核心宗旨，然而各領域對APC所收取的金額卻存在極大差異，生物醫學領域OA期刊APC收取金額最高，推測可能是受到BMC和PLoS兩家出版商最早於該領域採用APC機制所影響，以致生物醫學領域對OA的出版模式接受程度也相對較高（Solomon & Björk, 2012b）。林家鈺與林雯瑤（2021）探討醫學領域開放取用期刊文章處理費機制及其金額分布，發現醫學領域OA期刊APC金額差異大，介於113至6,000美元，並以收取3,000美元的期刊為最多。

雖然目前對於未來OA期刊APC機制的運作走向仍未可知，但已有部分研究指出APC是支持OA期刊營利的主要途徑（Davis & Walters, 2011; Laakso & Björk, 2012）。Copiello（2020）更是針對Elsevier APC的定價表進行分析，表示若將其所出版的文章皆採用OA模式發行，要維持出版利潤，則APC收取的平均金額將提高並落在4,173至4,482美元之間。

有關APC費用的訂定標準，Solomon與Björk（2012b）指出其收費金額會受不同領域、期刊出版國家、文章數，以及影響力影響，且期刊排名影響力越高的期刊所收取APC金額相對越高。Dorta-González等（2017）同樣表示目前完全OA期刊的影響力排名普遍偏低，而排名較高的期刊則明顯收取較高額的APC，導致部分研究人員無力負擔該費用，並擔心無法將其研究成果發表在影響力高的OA期刊，進而產生科學資源不平等的現象（Papin-Ramcharan & Dawe, 2006; Siler et al., 2018; Solomon & Björk, 2012a）。OA期刊出版模式雖可提升研究人員取得更廣泛資訊的機會，但出版單位收取高額APC的運作方式，是否亦會衍生阻礙作者出版的問題（Sotudeh & Ghasempour, 2018）？

基於對OA期刊APC費用的好奇，且考慮到不同領域接受OA出版模式的差異（Solomon & Björk, 2012b; Solomon et al., 2013），是以生物醫學領域APC普遍收取金額較高（Solomon & Björk, 2012b; Walters & Linvill, 2011），以及目前尚

未普遍探討期刊出版特徵是否可能為影響APC金額的潛在相關因素等考量，本研究從期刊出版和影響力的角度切入，著重探討醫學領域APC定價是否與期刊的刊齡、頻率、文章規模等出版特徵，以及各引用影響指標表現有所關聯，提出的具體研究問題為：

㈠醫學領域以OA模式出版之期刊APC金額與出版特徵之間的關係為何？

㈡醫學領域以OA模式出版之期刊APC金額與影響係數、期刊排名和立即指數的關係為何？

二、文獻探討

㈠ OA期刊的發展與影響力

對學術界而言，網際網路的出現不只大幅提升學術傳播的效率，還有效降低出版印刷、編排、傳遞的成本，而OA的興起無疑為學術出版與傳播體系帶來新的變革，尤其有利於發展中國家研究人員在知識取用方面的需求，並對研究產生積極正面的效用（Baro & Eze, 2017; Smith et al., 2017; Tang et al., 2017）。

OA模式的出版成本雖比傳統紙本形式較低，但仍需人力與物力的支持，故其出版運作成本依然存在（邱炯友，2006）。不同於以往傳統TA期刊由出版商向圖書館等使用者收取訂閱費的出版模式，OA期刊出版成本由作者或其所屬機構支付，這種向作者收取APC的出版方式無疑打破過往的學術出版慣例，質疑OA期刊運作模式與出版品質的相關議題也逐漸增加。

有關OA期刊的發展，有將依靠傳統訂閱發行之期刊直接轉為以OA的形式出版，亦有僅發行OA期刊如BMC和PLoS等之全OA出版商，更有像Elsevier和Springer Nature等大型商業出版公司採用雙軌出版模式，於同一本期刊中同時保留訂閱形式與OA模式的文章，讓作者自由選擇其研究成果的出版方式（Björk & Solomon, 2012）。

雖然目前OA機制已逐漸成長，但因該出版形式較為新穎，且歷史相較傳統TA期刊來說也比較短暫，因此學術社群成員對於是否將文章以OA模式出版仍會有所顧慮，然而無論傳統TA期刊或OA期刊，研究人員在投稿時最為關心的無非是期刊的品質與影響力（Anderson, 2004; Baro & Eze, 2017）。

對於OA出版的影響力，自發展以來即存在許多爭辯，許多研究人員也嘗試利用不同方法與角度探查其優劣，有以期刊為單位做探討（Fukuzawa, 2017; McVeigh, 2004; Yan & Li, 2018），有單就同一期刊中OA文章與付費文章角度做分析（Antelman, 2004; Eysenbach, 2006; Xia et al., 2011），亦有學者探查OA出版形式是否真的具有被引用優勢（Harnad & Brody, 2004; McVeigh, 2004; Moed, 2007; Norris et al., 2008; Sotudeh et al., 2015），且有鑑於OA出版形式具有免費公

開全文的機制，能提升文章的能見度並增加其被下載、閱讀及被引用的機會，故在分析影響力時，尤其關注OA模式出版後第一年立即被引用的效益。

㈡ APC的運作與收費

有鑑於期刊出版形式的改變，OA開創不同於以往的學術傳播模式，但不論傳統TA期刊，抑或新興發展的OA期刊，期刊的出版與運作皆需要成本。OA期刊雖號稱不向讀者收費，卻是將原本沉重的訂閱費轉換成作者或所屬機構支付APC，以維持出版商的營運，故APC機制的施行會受到作者投稿動機與經濟負擔能力影響，APC運作的持續性亦有待觀察及檢驗（Nelson & Eggett, 2017; Sotudeh & Ghasempour, 2018）。

不過也有學者以正面角度切入，認為OA出版方式相比傳統TA期刊更具市場潛力，因有支付APC的壓力，故作者在投稿時即須評估該期刊APC金額是否與自身的出版需求相符，促使營利性出版商為吸引更多作者投稿，進而努力精進所提供的服務與APC費用的合理性（West et al., 2014）。

有關APC費用的收取，先前研究已發現不同類型出版商APC定價金額有明顯差異（Solomon & Björk, 2012b; Pinfield et al., 2016），該費用又主要集中支付給大型商業營利性出版公司（Smith et al., 2017）。Walters與Linvill（2011）卻提出不同看法，認為大型商業出版商與非營利出版單位所收取的APC金額中位數差異不大，APC金額差異主要受不同領域影響，並以生物學和醫學領域所收取的費用最高。

不同出版機構APC的計價方式也有所不同，出版商聲稱APC是為支付文章的編輯、排版、審查工作，以及額外的圖表和附錄等補充資料（Monson et al., 2014），但該費用的計算方式卻相當多元，且對應的金額也有差異。林家鈺與林雯瑤（2021）研究JCR-SCIE醫學領域2,665種期刊的APC，發現該領域期刊APC可整理歸納成六大計費模式，分別為收取固定金額（74.95%）、依文章流通限制程度（11.53%）、不向作者收費之補貼型期刊（5.15%）、依文章類型或篇幅（3.42%）、作者身分（2.75%）和其他計價方式（0.28%），以收取固定APC金額的期刊為最多。

若連結OA期刊APC金額與影響力的關係，相關研究指出OA期刊的發展會受到期刊出版機構類型、期刊出版規模與國家政策的影響（Gadd et al., 2018），且APC的標準也因出版地區、文章數、學科類別及期刊影響力而有所差別（Solomon & Björk, 2012b），但也有以印度期刊為對象的研究指出，APC金額的高低與期刊影響係數並無直接關係（Mukherjee, 2014）。

為瞭解影響APC金額的相關因素，部分研究各自從出版商國家、規模和引響力指標等不同角度探討進行探討（Budzinski et al., 2020; Mukherjee, 2014; Pinfield et al., 2017; Smith et al., 2017; Solomon & Bjoerk, 2012a, 2012b; Wang et al.,

2015; Yuen et al., 2019），且多數研究表明期刊影響力與APC金額的高低具有相關性。

Solomon與Björk（2012b）指出，在JCR中具有高影響係數期刊所收取的APC費用為最高，平均費用為1,553美元，而在JCR中影響力較低的期刊則多由非歐美的國家所出版，且期刊收取的APC費用較低。Asai（2021）則是分析BMC和Hindawi兩大OA期刊出版商APC金額變化的因素，發現隨著引用次數的增加APC金額也隨之上漲。

然而，也有研究指出複合式OA期刊APC的定價與期刊影響力間的關係很難解釋（Björk & Solomon, 2014）。Yuen等（2019）更比較APC金額與IF、h-index、SJR、Eigenfactor、Article Influence Score和h5指數這六項期刊引用影響指標間的相關性，研究結果表示APC與期刊影響力相關性較低，並呼籲作者在投稿前應謹慎評估。

若從文章使用層面評估APC的收費金額，Hampson與Stregger（2017）認為APC為文章出版後永久使用的一次性成本，故為瞭解出版機構APC的收費與文章使用效益，嘗試從文章使用角度探討APC，研究結果顯示OA文章僅在文章出版三年後的每次使用成本較低，但有別於傳統TA期刊文章有受訂閱機構內人員使用之限制，OA文章因可公開讓大眾取閱，故隨時間推移每次使用成本將下降更多，透過該觀點的切入，期望提供圖書館新角度衡量OA模式出版的價值，以及評估採用OA出版期刊或傳統TA期刊的投資報酬率。

Smith等（2017）同樣為評估OA文章在全球衛生研究領域中的使用、成本與影響，檢索PubMed 2010年至2014年間發表在全球健康醫學主題詞表，並計算以OA出版之627篇文章的APC費用，發現總費用為170萬美元，平均每位研究者需支付2,732美元的APC，且有93.4%文章APC是被國際最知名的10家出版商期刊所收取，其中又以Elsevier位居第一。

至今OA模式之APC機制已逐漸受競爭激烈的出版市場影響，OA期刊每年的APC金額也略有不同，故研究人員在選擇將研究成果以OA形式出版時，仍應考慮出版機構收取APC金額的合適性，甚至可呼籲資助單位或負責機構制定APC相關的補助政策，以創造合適的投稿環境（Björk & Solomon, 2014）。

三、研究方法

㈠ 研究設計

本研究利用書目計量法蒐集JCR-SCIE 2017年版醫學領域完全OA期刊，並搭配使用WoS中的SCI-EXPANDED篩選出在JCR被標示為非OA期刊但實際上有出版OA文章之複合式期刊，以期能有效選出可能採用APC機制之期刊，並探討各期刊相應之APC對期刊出版特徵與引用影響指標的關聯性。

因期刊的篩選採用JCR與WoS兩種資料庫，故須使用可兼容兩種資料庫之學科分類作為判斷醫學領域學科的依據，因此本研究醫學領域的定義是以Clarivate Analytics公司所提供的Global Institutional Profiles Project（GIPP）學科領域分類表內Clinical, Pre-Clinical & Health類別之學科所收錄的期刊為主。

在探討各學科期刊APC金額與刊齡、出版頻率、OA文章數等變項的分布時，為能清楚呈現APC與任一個變項兩者的分布位置（例如：APC金額與刊齡的分布情形），以變項整體期刊的中位數為X軸、APC金額中位數為Y軸，劃分出四個象限，依序可分出第一象限APC與變項值皆高的A區、第二象限APC金額高但變項值較低的B區、第三象限APC金額與變項值皆低的C區，以及第四象限APC金額低但變項值高的D區，以瞭解不同區塊所分布的意義。四象限分布之區塊定義如圖1所示。

圖1　四象限分布之區塊定義

㈡研究對象

JCR-SCIE 2017年版的47個醫學相關學科共收錄3,825種期刊，其中有採用OA出版模式期刊共計3,420種，包含完全OA期刊488種，複合式OA期刊2,932種，因同一期刊可能同時被歸類在不同的學科而造成重複計算現象，故扣除重複計算後共2,665種OA期刊。醫學領域各學科詳細期刊的數量詳見表1。

然而考量到APC計價方式非常多樣且複雜，會受到不同授權條款組合或文章開放時間差異的影響，一種期刊可能會依不同條件而有多組APC定價，故分析時僅以有一組固定APC價格之2,037種期刊作為分析依據，並以期刊角度探討APC機制與出版特徵和期刊影響力的關聯性。

表 1　醫學領域各學科期刊數量

領域編號	學科領域	JCR 總期刊數	完全OA 期刊數	複合式OA 期刊數	OA期刊 總 計
S01	ALLERGY	27	5	19	24
S02	ANESTHESIOLOGY	31	2	24	26
S03	AUDIOLOGY & SPEECH-LANGUAGE PATHOLOGY	25	2	22	24
S04*	CARDIAC & CARDIOVASCULAR SYSTEMS	128	15	106	121
S05*	CLINICAL NEUROLOGY	197	15	169	184
S06	CRITICAL CARE MEDICINE	33	2	26	28
S07	DENTISTRY, ORAL SURGERY & MEDICINE	91	8	64	72
S08	DERMATOLOGY	64	7	46	53
S09	EMERGENCY MEDICINE	26	3	21	24
S10	ENDOCRINOLOGY & METABOLISM	142	18	106	124
S11	GASTROENTEROLOGY & HEPATOLOGY	80	7	68	75
S12	GERIATRICS & GERONTOLOGY	53	9	41	50
S13	HEALTH CARE SCIENCES & SERVICES	94	16	75	91
S14	HEMATOLOGY	71	4	62	66
S15	INFECTIOUS DISEASES	88	20	62	82
S16	INTEGRATIVE & COMPLEMENTARY MEDICINE	27	5	17	22
S17	MEDICAL ETHICS	16	3	12	15
S18	MEDICAL INFORMATICS	25	4	20	24
S19	MEDICAL LABORATORY TECHNOLOGY	30	2	20	22
S20*	MEDICINE, GENERAL & INTERNAL	155	43	86	129
S21	MEDICINE, LEGAL	16	0	16	16
S22	MEDICINE, RESEARCH & EXPERIMENTAL	133	31	83	114
S23	NEUROIMAGING	14	1	12	13
S24*	NURSING	118	5	98	103
S25	NUTRITION & DIETETICS	83	11	58	69
S26	OBSTETRICS & GYNECOLOGY	82	5	70	75
S27*	ONCOLOGY	223	38	167	205
S28	OPHTHALMOLOGY	59	7	47	54
S29	ORTHOPEDICS	77	12	55	67
S30	OTORHINOLARYNGOLOGY	41	4	32	36
S31	PATHOLOGY	79	9	56	65
S32	PEDIATRICS	124	8	107	115
S33	PERIPHERAL VASCULAR DISEASE	65	3	58	61
S34	PHARMACOLOGY & PHARMACY	261	27	204	231
S35	PRIMARY HEALTH CARE	19	5	9	14
S36*	PSYCHIATRY	142	14	112	126
S37*	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	181	39	123	162
S38*	RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING	129	16	102	118
S39	REHABILITATION	65	7	54	61
S40	RESPIRATORY SYSTEM	60	10	47	57
S41	RHEUMATOLOGY	30	5	24	29
S42	SPORT SCIENCES	81	10	63	73
S43	SUBSTANCE ABUSE	19	1	17	18
S44	SURGERY	200	9	169	178
S45	TRANSPLANTATION	25	1	23	24
S46	TROPICAL MEDICINE	20	9	8	17
S47	UROLOGY & NEPHROLOGY	76	11	52	63
總 計		3,825	488	2,932	3,420

註：總計期刊數包含重複期刊之數量。
*該學科有期刊於本研究資料蒐集過程中發生依期刊官網資訊更正OA出版類型之情形。

㈢ 分析項目

本研究欲分析之期刊出版特徵資訊，如出版頻率、出版文章篇數等均可直接經由JCR-SCIE資料庫取得，期刊創刊年則需進入官方網站查詢。期刊指標選擇學術界最普遍用來衡量期刊影響力之影響係數（Impact Factor，簡稱IF）與期刊學科領域排名（journal ranking）作為分析依據，同時考慮到OA期刊透過網路免費近用可提高其能見度與被引用機會的特性，亦將可以代表期刊於特定出版年份即時被引用的立即指數（Immediacy Index，簡稱II）納入分析之項目，並以JCR-SCIE所提供的數據為準。

在APC金額的計算部分，由於其計價規則多元，OA文章會受到不同授權條款組合或開放時間差異而有不同的計價方式，考量研究的可行性，本研究在計算期刊APC時僅以單一固定價格計算，且因本研究資料蒐集時間橫跨2019年的上半年，故在標示APC金額時一律以2019年上半年的平均匯率轉換以美金計價。

四、研究結果與分析

㈠ APC與期刊出版特徵的關聯性

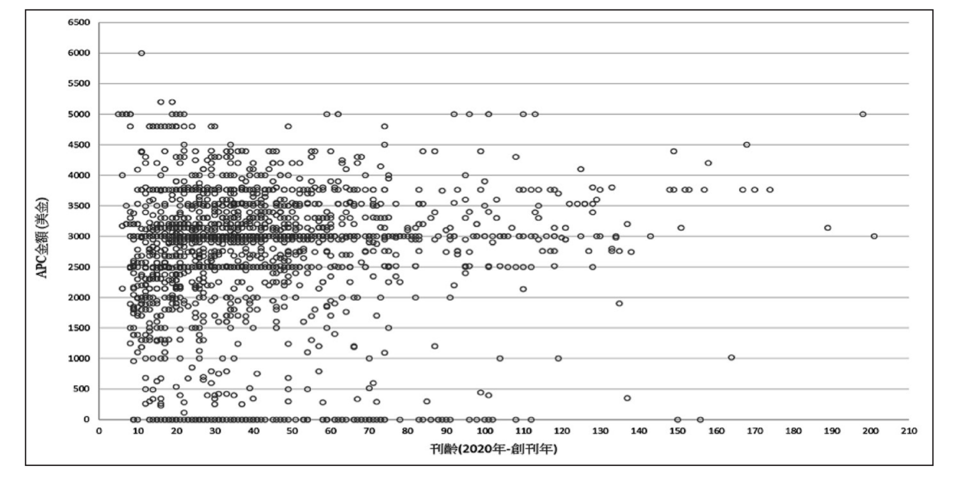
1. 刊齡

由於期刊的出版需要時間來累積聲譽，故在此前提下，一般而言會認為期刊歷經的時間越長，也就是創刊的時間越早，其品質與影響力也就會越高，進而越有可能吸引作者將文章投稿至該期刊，經年累月之後，期刊所訂定的APC費用金額也可能會越高。

本研究以整體領域扣除未提供創刊年資訊與重複共計2,036種期刊進行Pearson相關係數的分析。根據結果顯示，創刊年距2020年之刊齡與APC金額相關係數為 .041（p = .066），表示期刊刊齡與APC金額於統計學上並無顯著的相關性。

以2010年創刊的*Diabetes Therapy*為例，該期刊收取之APC為6,000美元，為整體領域APC金額最高之期刊，刊齡卻僅有11年歷史。反之，1820年創刊的*The American Journal of the Medical Sciences*擁有201年之刊齡，但期刊APC為整體期刊的中位數3,000美元。由此可見，早期所創立之期刊有可能收取低價的APC，而越晚近創辦之期刊也有可能收取高額APC的費用，醫學領域期刊APC的收取以集中在3,000美元者為最多數。整體領域OA期刊刊齡與APC金額分布如圖2所示。

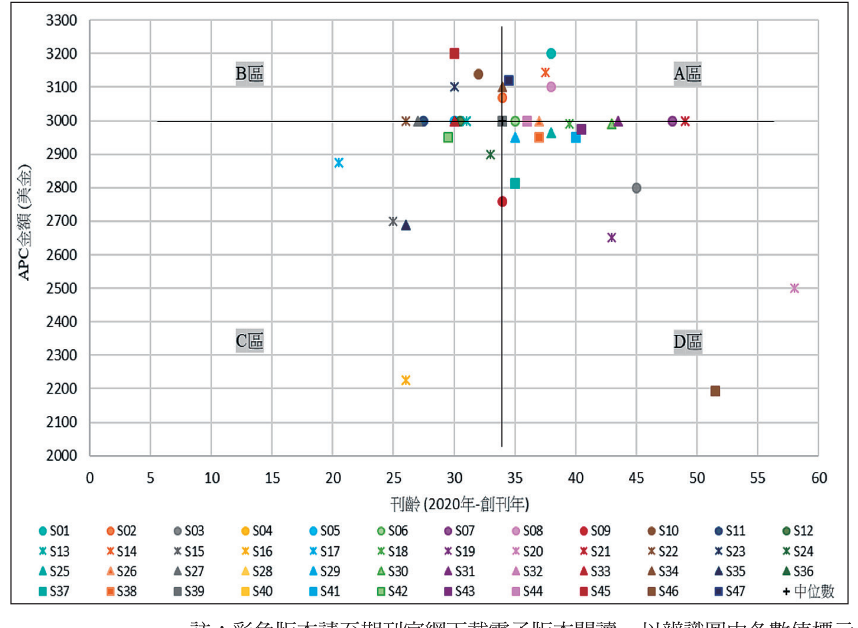
圖2 醫學領域OA期刊刊齡與APC金額之分布



若探討各學科期刊刊齡及APC金額中位數之分布位置，以瞭解不同學科的差異，各學科的分布多集中於APC金額3,000美元，APC中位數最高之學科則分別為位於B區編號S45的TRANSPLANTATION與A區編號S01的ALLERGY，這兩門學科所分布的區域位置，雖APC中位數相同，但期刊刊齡之中位數卻有落差。反之，期刊APC收取金額中位數明顯較低之學科為位於D區編號S46的TROPICAL MEDICINE，屬熱帶醫學之範疇，推測該學科期刊APC收取費用最低的原因是受到其研究主題與關注議題多集中在位於熱帶地區中低收入國家的疾病，故期刊投稿之文章多來自這些無法負擔高額費用的作者，導致該學科期刊APC金額定價門檻較低，其次為位於C區編號S16的INTEGRATIVE & COMPLEMENTARY MEDICINE，為綜合與補充醫學屬替代醫學之領域，根據美國國家衛生研究院（National Institutes of Health，簡稱NIH）對於該領域之說明為透過嚴謹的科學研究確定補充或替代醫學措施的有效性與安全性，並以協調的方式將傳統治療方法和補充輔助之醫療方式結合，推測該學科APC金額較低的原因，為該領域相對於一般醫學學科範圍較小，且學科於1990年代後開始受到關注，故發展時間相對較晚。

此外，各學科的分布較為特別的是位於D區編號S20的MEDICINE, GENERAL & INTERNAL，該學科期刊的發展歷程最早，但所收取的APC金額卻相對較低，而在所有學科領域中，編號S04的CARDIAC & CARDIOVASCULAR SYSTEMS、S36的PSYCHIATRY，以及S39的REHABILITATION刊齡與APC金額分布剛好位於整體領域期刊的中心位置。各學科OA期刊刊齡與APC金額中位數之分布如圖3所示。

圖3　各學科OA期刊刊齡與APC金額中位數之分布



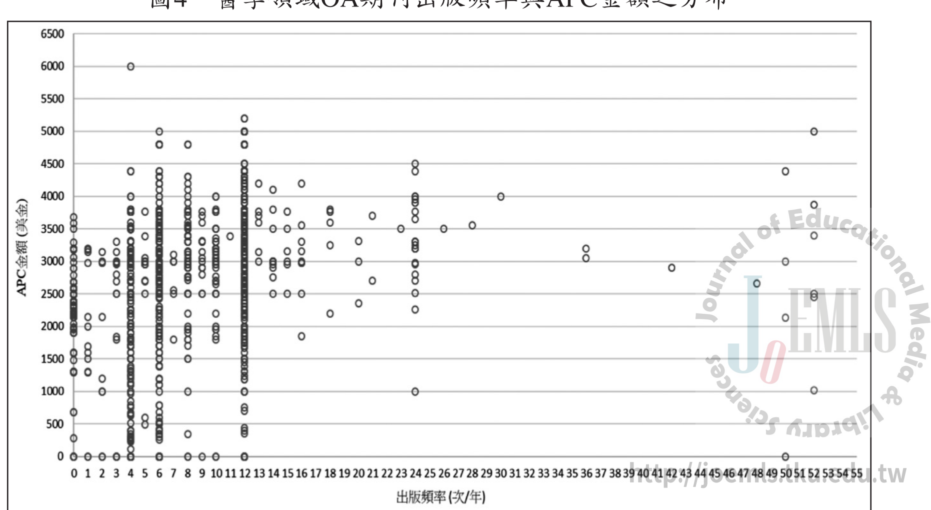
註：彩色版本請至期刊官網下載電子版本閱讀，以辨識圖中各數值標示。

2. 出版頻率

期刊出版頻率越高，文章處理出版的程序就越頻繁，APC收取的費用金額可能就越高，為瞭解期刊出版頻率與APC金額是否具有關聯性，以2,037種期刊進行Pearson相關係數的分析。

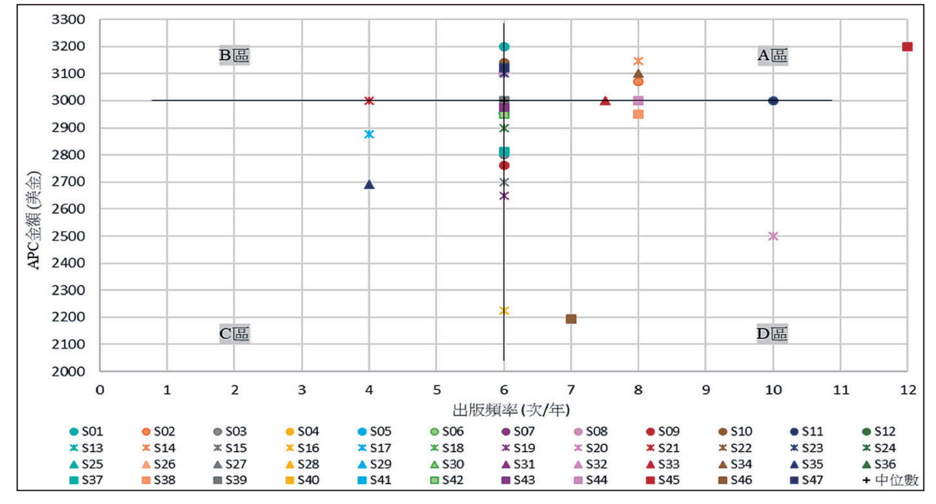
根據結果顯示，期刊出版頻率與APC金額相關係數為.239（p = .000），在.001的顯著水準下具有相關性，表示APC收取的費用金額可能會受到期刊出版頻率高低所影響。整體領域OA期刊出版頻率與APC金額分布如圖4所示。

圖4　醫學領域OA期刊出版頻率與APC金額之分布



分析各學科出版頻率與APC金額中位數的分布，以一年出版六次頻率的學科為最多數，而APC收取金額最高者分別是編號S01的ALLERGY和S45的TRANSPLANTATION，其中編號S45的TRANSPLANTATION同時也是全體出版頻率中位數最高之學科。各學科OA期刊出版頻率與APC金額中位數分布如圖5所示。

圖5　各學科OA期刊出版頻率與APC金額中位數之分布



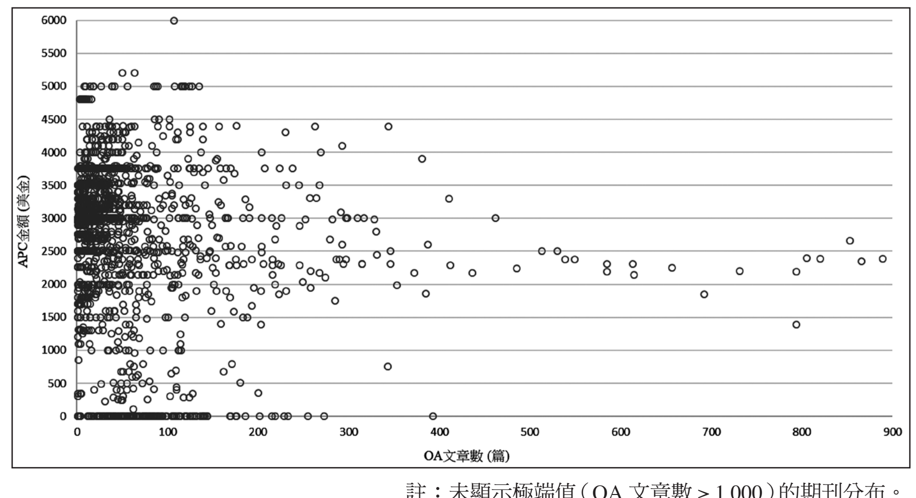
註：彩色版本請至期刊官網下載電子版本閱讀，以辨識圖中各數值標示。

3. OA文章數

為瞭解期刊2017年出版OA文章數多寡與APC金額高低是否具有關聯性，茲以2,037種期刊進行Pearson相關係數的分析。

根據結果顯示，期刊出版OA文章數與APC金額相關係數為–.150（p = .000），在 .001的顯著水準下呈現負相關，也就是說，當OA文章數越少，APC收取的金額則越高，推論呈現該結果的原因是受到不同OA期刊類型差異所影響，由於複合式OA期刊以出版1至50篇的OA文章為最多數，又以集中出版10篇以下的期刊較多，但其APC費用卻相對於完全OA期刊所收取的金額較高，故造成整體期刊出版OA文章數與APC費用呈現負相關。其中2017年出版OA文章數大於1,000篇者有八種期刊，但值得注意的是，簡稱這種期刊所收取之APC金額皆低於整體期刊APC的中位數（3,000美元），顯示出版社在考量APC定價時，出版文章數量可能並非最主要的影響條件。2017年出版OA文章數大於1,000由高到低的期刊依序為*BMJ Open* 2,555篇（1,741.5美元）、*Biomed Research International* 1,927篇（1,990美元）、*Oncology Letters* 1,821篇（1,190美元）、*Molecular Medicine Reports* 1,801篇（1,450美元）、*International Journal of Environmental Research and Public Health* 1,568篇（1,800美元）、*Experimental and Therapeutic Medicine* 1,417篇（1,190美元）、*Nutrients* 1,325篇（2,000美元）、BMC PUBLIC HEALTH 1,022篇（2,390美元）。整體領域期刊2017年出版OA文章數與APC金額分布如圖6所示。

圖6　醫學領域期刊2017年出版OA文章數與APC金額之分布

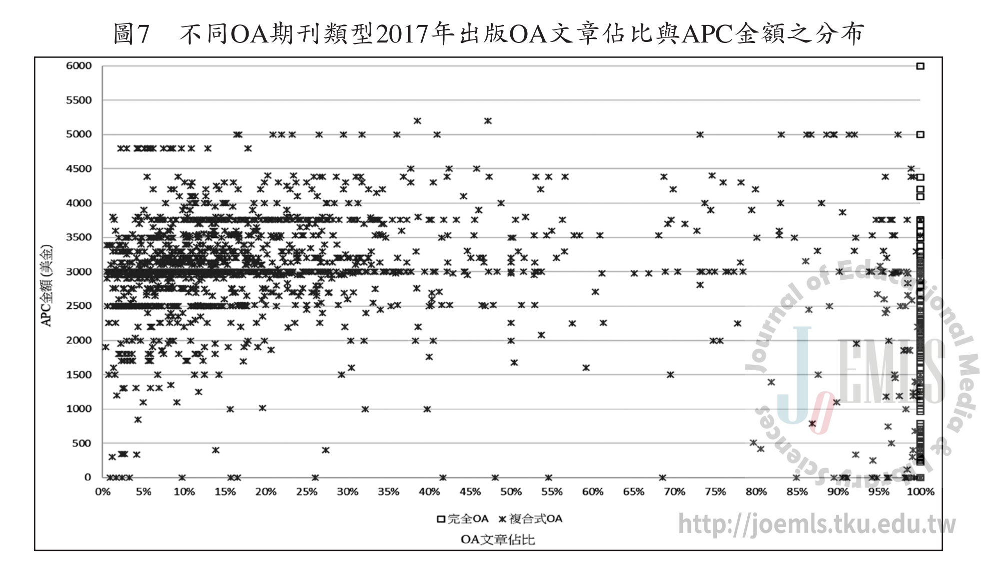


註：未顯示極端值（OA 文章數 ≥ 1,000）的期刊分布。

考慮到期刊不同OA類型出版的OA文章數有所差異，本研究特別將複合式OA期刊出版之OA文章與總文章數計算其OA文章的佔比，並探討與APC金額的相關性，總計349種完全OA與1,688種複合式OA期刊，進行Pearson相關係數的分析。

根據結果顯示，完全OA期刊出版之文章數與APC金額的相關係數為 .166（p = .002），在 .01的顯著水準下具有相關性，表示當完全OA期刊出版的OA文章越多，所收取的APC費用可能越高；而在複合式OA期刊的部分，OA文章佔比與APC金額的相關係數為 –.201（p = .000），在 .001的顯著水準下呈現負相關，顯示出版較少OA文章的複合式OA期刊普遍收取較高額的APC。不同OA類型期刊2017年出版之OA文章佔比與APC金額分布如圖7所示。

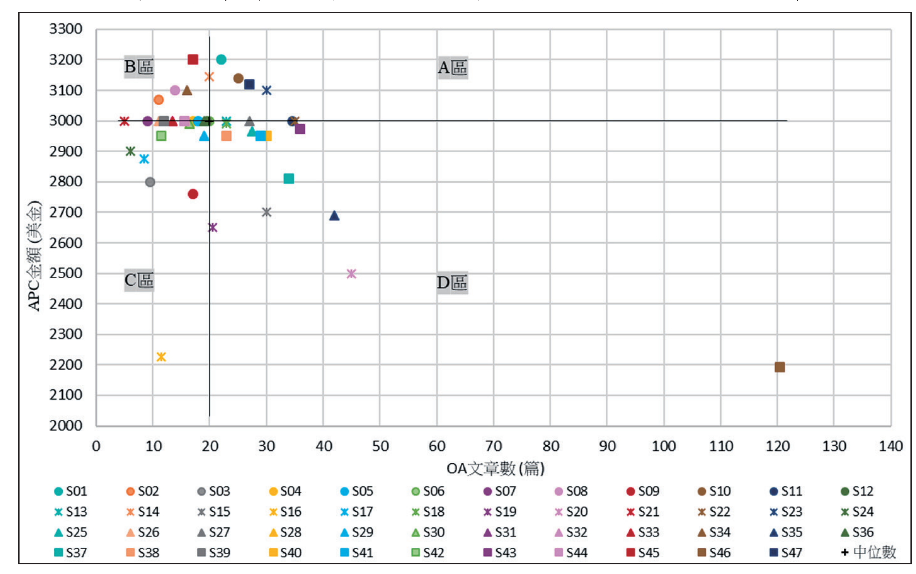
圖7　不同OA期刊類型2017年出版OA文章佔比與APC金額之分布



在各學科出版OA文章數與APC金額中位數分布部分，以D區的學科分布最為分散，且在該區塊中出版OA文章中位數最多（120.5篇）的學科為編號S46的TROPICAL MEDICINE，其APC收取金額中位數同時也是整體領域價格最低者，而APC收取金額次低的學科為位於C區編號S16的INTEGRATIVE & COMPLEMENTARY MEDICINE，但其出版之OA文章中位數（11.5篇）明顯較TROPICAL MEDICINE少。整體領域出版OA文章中位數最低者（五篇）為編號S21的MEDICINE, LEGAL，其APC收取金額中位數為3,000美元。

此外，若探討APC收取金額中位數最高之學科，則分別為位於A區編號S01的ALLERGY以及B區編號S45的TRANSPLANTATION。各學科2017年出版OA文章數與APC金額中位數之分布如圖8所示。

圖8　各學科2017年出版OA文章數與APC金額中位數之分布



註：彩色版本請至期刊官網下載電子版本閱讀，以辨識圖中各數值標示。

㈡ 期刊指標與APC的關聯性

1. IF與APC相關性

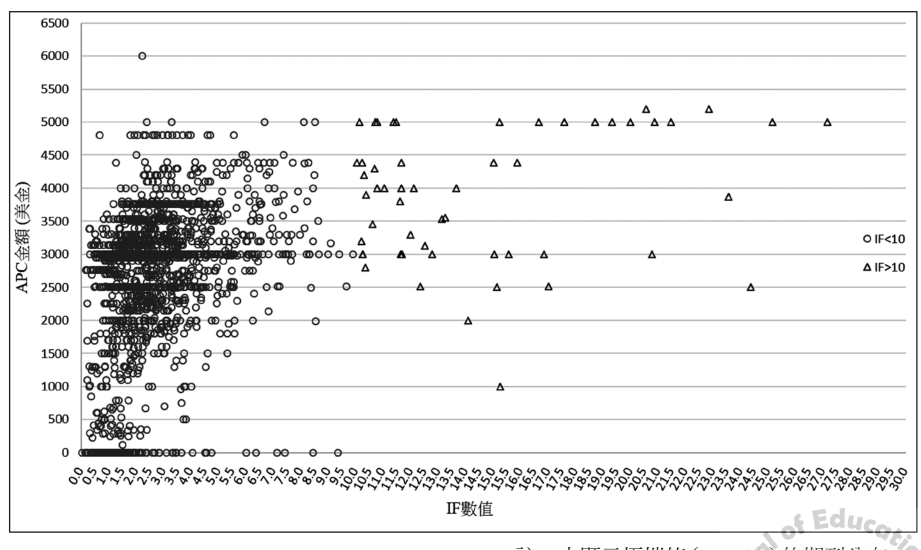
由於期刊聲望與影響力會是影響作者是否願意將文章投稿至期刊的重要因素，在此前提下，一般認為期刊IF值越高，則影響力越大，APC收取金額相對來說可能也就會越高，故此，本研究將2,037種期刊，扣除五種因未提供IF資料而排除計算，最後總計以2,032種期刊進行Pearson相關係數的分析。

根據結果顯示，期刊IF數值與APC金額相關係數為 .168（p = .000），在 .001的顯著水準下具有相關性。因出現少數期刊IF明顯較高的極端值，為更深入瞭解期刊IF差異對APC金額高低的關係，本研究將IF值依大到小排序，並篩選出IF最高的前3%（IF ≥ 9.333）為基準，且為方便比較期刊的分布情形，故取整數將期刊區分IF值大於10與小於10的兩個群組進行分析。

在IF值大於10的組別中，共有57種期刊，與APC金額的相關係數為 .025（p = .854），結果顯示並不具有顯著相關性；而IF值小於10的組別則共計有1,975種期刊，與APC金額的相關係數為 .312（p = .000），在 .001的顯著水準下具有相關性。藉由研究結果可知，期刊IF值越大，所收取的APC費用可能越高，且當IF值大於一定標準（IF > 10）時，所收取之APC費用並無法找出具合理的解釋依據。

探討整體期刊分布，IF值最低為0.019由阿根廷的透析和腎臟移植區域協會（Asociacion Regional de Dialisis y Trasplantes Renales）所出版，不收APC的補貼型期刊*Revista de Nefrologia Dialisis y Trasplante*；IF值最高為244.585隸屬於美國癌症協會（American Cancer Society），且由Wiley所出版的*CA-A Cancer Journal for Clinicians*，APC收取金額為3,600美元。不收APC的補貼型期刊，IF數值則多集中在10以下。此外，於所有期刊中，IF數值明顯較高（IF > 30）共有三種，分別為由Elsevier所出版的*Lancet Oncology*（IF = 36.421）和*Lancet*（IF = 53.254），APC收取金額皆為5,000美元，以及由Wiley出版的*CA-A Cancer Journal for Clinicians*（IF = 244.585），APC為3,600美元。期刊IF與APC金額分布見圖9。

圖9　期刊IF與APC金額分布



註：未顯示極端值（IF > 30）的期刊分布。

由於訂定期刊APC金額的主要單位為出版機構，故本研究也依據商業型、學協會、學術機構、不同單位合作出版，以及其他等不同出版機構類型，進行Pearson相關係數的分析，以探討各出版機構期刊IF與APC金額的關聯性。不同出版機構期刊中，以不同單位合作出版之期刊數1,029為最多，IF值介於0.147至244.585，APC收取金額為0至6,000美元，相關性為 .091（p = .004），

雖然在 .01的顯著水準下具有相關性，但相較於其他出版機構類型，其相關性為最低，推測是因為在該類別中，期刊的出版單位組合多元且複雜，負責制定APC機制的負責單位也各不相同，故導致該出版單位類型所出版之期刊整體APC分布的金額較為分散。期刊數排名第二為商業型出版社所出版共823種期刊，IF數值介於0.170至53.254，APC金額分布在0至5,200美元，相關性為 .391（p = .000），在 .001的顯著水準下同樣具有相關性，在該出版機構類型中，APC的金額分布以集中在3,000美元的期刊為最多，且若觀看IF大於10的期刊，則APC收取金額皆為3,000美元以上，其分布大致呈現IF較高之期刊APC收取金額相對也較高的趨勢。期刊數排名第三為學協會出版共90種期刊，IF數值介於0.019至24.373，APC金額分布在0至5,000美元，相關性為 .642（p = .000），在 .001的顯著水準下呈現中度相關。最後則是由學術機構所出版共65種期刊，IF數值介於0.288至7.422，APC金額分布在0至3,528美元，相關性為 .261（p = .038），在 .05的顯著水準下具有相關性。不同出版機構類型OA期刊IF與APC金額的相關性見表2。

表2　不同出版機構類型OA期刊
IF與APC金額之相關性

出版機構類型	期刊數	相關性
商業型出版社	823	.391** （.000）
學協會	90	.642** （.000）
學術機構	65	.261* （.038）
不同單位合作出版	1,029	.091** （.004）
其他	25	--
總 計	2,032	--

註：括弧內為顯著性，但因其他出版機構類型期刊數較少，不具統計意義，故不列入相關性的分析。
* 相關性在 .05水準下顯著（雙尾）。
** 相關性在 .01水準下顯著（雙尾）。

2. 期刊排名與APC相關性

若以期刊排名角度計算IF值的佔比，則可探討各學科期刊於四分位數分布與APC金額的關聯性，故本研究也依期刊排名分布與APC金額進行Pearson相關係數的分析。整體學科包含重複共2,619種期刊，其與APC金額的相關係數為–.349（p = .000），在 .001的顯著水準下呈現負相關，表示當學科排名越好的期刊APC金額可能會越高。另就學科期刊於各別四分位數的分布分析與APC金額的關聯性，則根據結果顯示期刊排名分布在Q1與Q4區間內，其相關係數在 .01的水準下具有顯著性，但若在Q2及Q3區間則無法看出學科IF值排名佔比與APC金額相關的顯著性。藉由期刊四分位數排名分布的分析結果顯示，更加印證排名越前的期刊所收取的APC費用金額則越高，而排名較後的期刊APC收取費用相較之下較為便宜。期刊IF排名分布與APC金額的相關性詳見表3。

表3 期刊IF排名分布與APC金額相關性

排名分布	期刊數	相關性
整體	2,619	–.349** (.000)
Q1(1-25%)	671	–.119** (.002)
Q2(26-50%)	725	–.038 (.309)
Q3(51-75%)	719	–.017 (.651)
Q4(76-100%)	504	–.175** (.000)

註：期刊數依學科計算包含重複，括弧內為顯著性。
**相關性在 .01水準下顯著(雙尾)。

3. II與APC相關性

由於以OA形式所出版文章相對於傳統TA期刊取用限制較少，因此文章能見度與可被引用機會較高，除瞭解期刊IF的影響力外，也特別分析能代表期刊在特定年份當年度出版文章影響力的II數值，以瞭解其與APC金額的關係。

本研究以2,037種期刊進行Pearson相關係數的分析，根據結果顯示，期刊II數值與APC金額相關係數為 .227(p = .000)，在 .001的顯著水準下具有相關性。由於有出現部分期刊II值明顯較高的極端值，故本研究為進一步瞭解II值差異與APC金額的關聯性，將期刊分為II值大於1以及小於1的兩個小組進行分析。

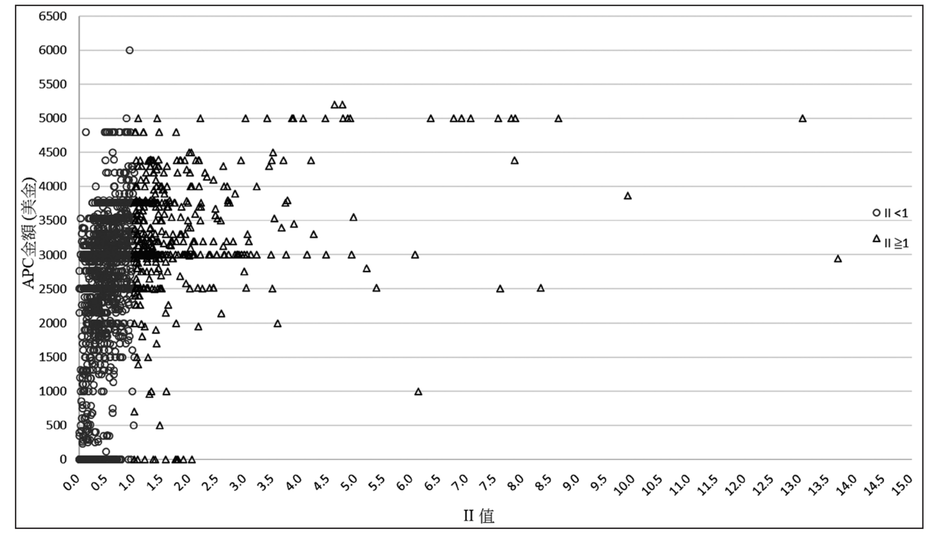
在II值大於1的組別中，共計有446種期刊，與APC金額的相關係數為 .142(p = .003)，在 .01的顯著水準下具有相關性；II值小於1的組別則共有1,591種期刊，與APC金額的相關係數為 .402(p = .000)，在 .001的顯著水準下同樣呈現相關，但II值小於1的組別相關係數 .402明顯較II值大於1的組別 .142高，表示在考量醫學領域期刊的APC時，期刊II值小於1的群組，大致呈現II值越大，APC收取金額越高。但若當II值大於1，則II與APC兩者間的相關性反而較低，換言之，當II值大於一定程度時，也比較難找出期刊APC的收費依據。

整體期刊中II值最低為0，共計有10種期刊，顯示這些期刊文章於2017出版當年未被引用，其APC金額則介於0至2,760美元；II值最高則為49.172由Wiley出版的*CA-A Cancer Journal for Clinicians*，APC收取金額為3,600美元。除此之外，也另有兩種II值明顯較高(II > 10)的期刊，分別為由Elsevier所出版的*Lancet*(II = 13.030)，其APC收取金額為5,000美元，以及由Taylor & Francis出版的*American Journal of Bioethics*(II = 13.667)，APC收取金額為2,950美元。期刊II值與APC金額分布見圖10。

(三) 綜合討論

在OA出版模式下，APC機制的產生是為因應文章出版成本所衍生出的解套辦法，而讓作者願意支付多少APC費用的程度，其一之因素會受到期刊聲望所影響，故探討期刊出版OA文章數、IF值與APC金額三變項的關係，總計2,032種期刊探討其分布。

圖10　期刊II值與APC金額之分布



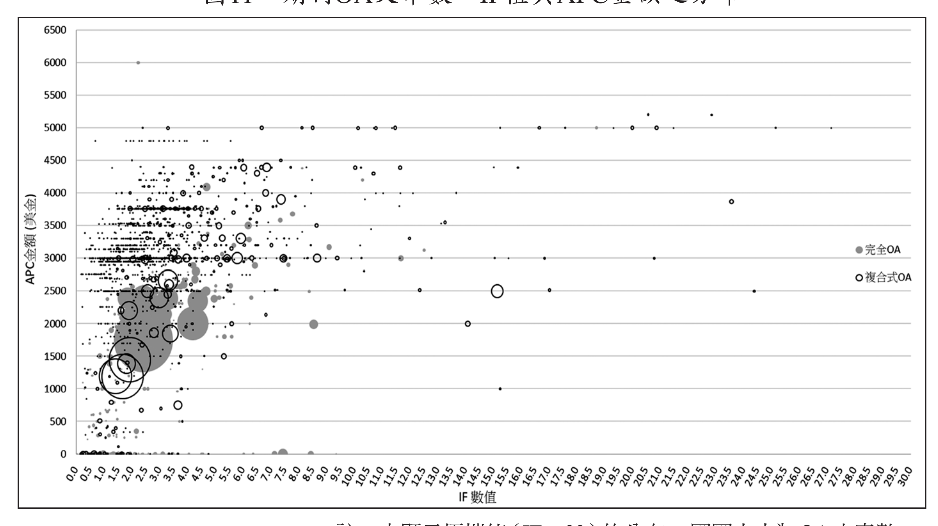
註：未顯示極端值 *CA-A Cancer Journal for Clinicians*（II = 49.172）的分布。

根據研究結果發現，在348種完全OA期刊中出版文章數較多者（大於1,000篇），其IF值多集中在2.145至4.196，APC金額介於1,742至2,390美元，而在所有期刊中出版文章數最多的 *BMJ Open*（2,555篇），其IF值為2.413，APC收取金額為1,350英鎊（換算約為1,742美元），反之，出版文章數最少為 *Emergency Medicine International*（七篇），IF值為0.519，APC收取金額為1,300美元；若以APC收取金額最多與最少的角度觀察，則以 *Diabetes Therapy*（6,000美元）APC金額最高，共出版107篇，IF值為2.224，而不收APC共計90種補貼型期刊，其出版文章數多分布在400篇以下，IF值為0.019至9.333；最後以IF值大小的分布探討，其中IF值最大的期刊為 *Lancet Global Health*（IF = 18.705），共出版85篇文章，APC收取金額5,000美元，而IF值最小的期刊則是 *Revista de Nefrologia Dialisis y Trasplante*（IF = 0.019），為不收APC的補貼型期刊，共出版18篇文章。

在1,684種複合式OA期刊中，出版OA文章數較多者（大於1,000篇），其IF值集中在1.410至1.922，APC金額介於1,190至1,450美元，其中出版OA文章數最多的 *Oncology Letters*（1,821篇）IF值為1.664，APC收取金額為1,190美元，而在所有期刊中出版OA文章數最少（一篇）共計有76種期刊，IF值分布在0.202至6.481，APC金額介於0至3,760美元；若從APC收取金額的角度探討，則以 *Cell Metabolism* 以及 *Cancer Cell*（5,200美元）兩種期刊收取金額最高，其出版的OA文章分別為64與50篇，IF值為20.565和22.844，而不收APC的41種補貼型期刊，出版OA文章數多分布在273篇以下，IF值介於0.147至4.750；最後探討IF值大小的分布，IF值最大的期刊為 *CA-A Cancer Journal for Clinicians*（IF

= 244.585），共出版24篇OA文章，APC金額為3,600美元，IF值最小為*Turkish Journal of Physical Medicine and Rehabilitation*（IF = 0.147），同樣為不收APC的補貼型期刊，共出版37篇OA文章。另在複合式OA中也可以發現期刊以收取3,000美元APC為多數，並以IF值為5以下且出版OA文章100篇以內的期刊分布最為密集。期刊OA文章數、IF值與APC金額之分布如圖11所示。

圖11　期刊OA文章數、IF值與APC金額之分布



註：未顯示極端值（IF > 30）的分布，圈圈大小為OA文章數。

五、結論與建議

本研究以JCR 2017所收錄的47個醫學領域期刊為研究對象，扣除重複共計分析2,037種收取固定APC金額之OA期刊，並從期刊出版特徵和影響力的角度切入，探討APC金額分布與期刊的刊齡、頻率、文章規模、IF值以及II數值的關聯性。

研究結果顯示，在期刊出版特徵方面，APC分布與刊齡於統計學上並無呈現顯著的相關性，該發現與Budzinski等（2020）探討出版商年齡與APC兩者關係的結論相似，年齡與APC金額並無法呈現直接的影響關係，仍需考慮其他因素，如出版商規模、期刊影響力等。故根據本研究結果推論早期所創立之期刊有可能收取低價的APC，反之，越晚近創辦之期刊也有可能收取高額的APC費用，而整體APC金額以集中在3,000美元期刊為最多，深入探究發現，因本研究分析對象以複合式OA期刊為多數，該結果與先前研究顯示不同OA期刊類型，APC分布的金額結果相符，複合式OA期刊APC金額集中在3,000美元，而完全OA期刊APC則主要分布在1,000至2,000美元（Björk & Solomon, 2014; Solomon & Björk, 2016）；APC的分布與出版頻率則呈現正相關，顯示APC收取的費用金額會受到期刊出版頻率所影響，各學科期刊以出版頻率高且APC收取

金額高的數量為最多；與OA文章數呈負相關，探討其原因為複合式OA期刊出版OA文章較少，但APC收取費用卻相對較高。

在期刊影響力方面，APC分布在期刊引用影響指標與APC分布方面，無論IF或II指標在 .001的顯著水準下與APC金額皆具有相關性，若進一步將IF值區分大於與小於10的兩個群組，則僅在IF值小於10的組別中APC金額與IF值具有相關性，顯示期刊影響力越高則APC收取的金額相對越高，然而當IF值大於一定程度時，APC的收費並無法找出具合理解釋的依據。而期刊排名方面，僅分布在Q1與Q4區間內具有顯著性，Q2及Q3區間則無法看出統計學意義的顯著相關性。分析II指標，則同樣區分大於與小於1的兩個群組，雖然皆顯示具有相關性，但相較之下II值小於1的群組相關係數較高，整體而言，研究結果呈現II值越高APC金額相對也會越高的趨勢。

藉由期刊出版特徵與影響力兩個面向探討與APC金額的關聯性，研究結果發現出版特徵與APC僅呈現低度相關，進一步顯示期刊出版單位在訂定APC時，可能還是以期刊影響力為主要的依據。

再對作者、資助單位或圖書館等不同對象提出建議，在作者方面，提醒挑選欲投稿的目標OA期刊時，可優先選擇影響力高但APC金額合理的期刊；資助單位則可根據不同學科領域挑選適當的期刊列為清單，且排除影響力低但收取高額APC之期刊，作為資助的依據；圖書館在推廣OA的同時，也應協助作者對APC機制有更進一步的認識，而在與出版商簽訂閱讀與出版協議（read-and-publish agreement，簡稱R&P）或出版與閱讀協議（publish-and-read agreement，簡稱P&R）之轉型合約時，亦應努力爭取機構內作者過去較常投稿OA期刊的APC折扣優惠，以利圖書館協調期刊訂閱費與APC的預算。

隨著OA文章數量的增長，APC的運作逐漸受到關注，然而本研究以醫學領域為研究標的，研究結果僅侷限於該領域情況，無從得知不同領域的運作，倘若未來可擴大範圍選擇不同領域期刊，並分析APC計價方式與金額分布，則可更清楚瞭解各領域OA機制的差異。此外，結果發現，不同期刊APC金額的分布差距極大，其中又以複合式OA期刊所收取的APC金額較高，故建議未來可採用問卷或深度訪談方式瞭解作者投稿OA期刊的動機、意願及看法，又或進一步深入探討作者投稿複合式OA期刊的原因，以及其願意支付最高之APC金額，最後也可調查圖書館、出版機構或資助單位人員對APC機制的認知、因應策略與看法，以幫助學術研究者更加瞭解APC的出版機制。

誌　　謝

本文作者感謝兩位匿名審查者詳細審閱，並提供寶貴的修改意見，使本文更臻完善。

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Journal of Educational Media & Library Sciences 59 : 2 (2022) : 169-199
DOI:10.6120/JoEMLS.202207_59(2).0012.RS.AM



Exploring Article Process Charge of Open Access Journals from the Perspectives of Publication Characteristics and Citation Impact Indicators: A Case Study in the Medical Field[ψ]

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Abstract

The complex APC operation mechanism of open access (OA) journal is generating discussion in the academic community. To understand the prices of APC, this study explored whether APC pricing in medicine is related to journal-related characteristics and journal influence-related indicators. In all, 47 medicine-related fields in JCR-SCIE 2017 were collected, among which 3,420 journals had published OA articles and 2,037 OA journals were analyzed, which removal of duplicate titles and picking out fixed APC prices. Results showed that APCs and journal age were not significantly correlated; journals established earlier may have charged lower APCs than those established later. Overall, the majority of OA journals charged approximately US$3,000. APCs and publication frequency were positively correlated, APCs increased with publication frequency. APCs and the number of articles published were negatively correlated, perhaps because hybrid OA journals published fewer articles but charged higher APCs. Regarding journal influence, IF and II values were significantly correlated with APCs. With respect to rankings, for journals ranked in Q1 and Q4, correlations between ranking and APC were significant. This study suggests that future may use questionnaires or conduct in-depth interviews to gain insight into why authors submitted articles to OA journals, their willingness to submit the articles and how prices they were willing to pay in APCs.

Keywords: *Open access, Article processing charge, Journal publishing characteristics, Impact factor, Journal ranking, Immediacy index*

ψ This article is based on the first author Chia-Yu Lin's master thesis "A Study of the Open Access Journal Article Process Charge in Medical: The Perspectives of Journal Publishing Characteristics and Citation Impact", and the original research idea is inspired by her advisor Wen-Yau Cathy Lin.

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Please visit JoEMLS website to read the Peer Review Report (Open Point) and Article Summary (InSight Point) of the article.
2022/04/24 received; 2022/07/13 revised; 2022/07/30 accepted

SUMMARY

Introduction

OA journals adopt complex operating methods, and some charge high publication fees, generating discussion in the academic community. Contrary to the publication methods adopted by toll access journals, OA journals require that authors or their organizations pay the publication costs. This payment is referred to as the “article processing charge” (APC), and it imposes a heavy burden on authors (Nelson & Eggett, 2017; Sotudeh & Ghasempour, 2018). Although the future operation of the APC mechanism of OA journals is still unknown, studies have revealed that APCs are the main source of profit for OA journals (Davis & Walters, 2011; Laakso & Björk, 2012).

Regarding standards for setting APCs, Solomon and Björk (2012b) commented that APCs vary by field, journal publishing country, number of articles published, and journal influence, where more influential journals (i.e., those with higher rankings) have higher APCs. Dorta-González et al. (2017) stated that, currently, full OA journals generally rank low in influence, and those that rank comparatively higher in influence charge higher APCs. Those researchers who cannot afford them agonize that their results will not be published in an influential OA journal. Concerns have been raised about the unequal distribution of scientific resources caused by such discrimination (Papin-Ramcharan & Dawe, 2006; Siler et al., 2018; Solomon & Björk, 2012a).

This study used journal publication characteristics and influence to investigate whether APC pricing in medicine is related to OA journal-related characteristics (i.e., the year the journal was established, the frequency that the journal publishes papers and the number of articles published) and journal influence-related indicators. The study questions were as follows:

1. In the field of medicine, what are the relationships between journal-related characteristics and APCs?
2. In the field of medicine, what are the relationships between APCs and the journal’s impact factor (IF), Journal Ranking and immediacy index (II) values?

Research Methods

This study used bibliometrics to collect medical domain-related full OA journals in JCR-SCIE 2017 and used the SCI-EXPANDED function of WoS to filter out hybrid journals that published OA articles but were not listed as OA journals in the JCR.

In all, 3,825 journals in 47 medicine-related fields in JCR-SCIE 2017 were counted, among which 3,420 had published OA articles. However, journals

can be listed under multiple categories and be counted multiple times; after the removal of duplicates, 2,665 OA journals were identified. Considering that APC charging method is very diverse and complex, and there will be different pricing amounts according to different conditions. Therefore, only journals with fixed APC are for analysis. In total 2,037 journals were calculated.

Concerning APCs, most OA journals have multiple pricing rules because OA articles have different authorization terms and publication durations. Nonetheless, to allow for comparisons, a fixed APC price was used when calculating the APC charged by a journal. Because the data were collected during the first half of 2019, the APCs were displayed in US$ based on the average exchange rate of this period.

Results

Correlations Between APCs and OA Journal-Related Characteristics

1. Year Journal Was Established

Pearson correlation coefficient analysis was conducted on 2,036 journals (one journal without publication year information was removed), and the coefficient between the year journal was established to 2020 is .041 (p = .066). For most categories, the APC was concentrated US$3,000.

2. Publication Frequency

Pearson correlation coefficient analysis of publication frequency and APC was .239 (p < .001), indicating significant correlation and that APC may be affected by publication frequency. The median publication frequency among the categories was six times a year. TRANSPLANTATION, which had both the highest median APCs and median publication frequency.

3. Number of OA Articles Published

In the Pearson correlation analysis of the number of OA articles published and APC was −.150 (p < .001), indicating that the number of OA articles published was negatively correlated with APC. In other words, the APC increased as the number of OA articles decreased. This result may have been caused by the different OA journal types.

Concerning the medians of number of OA articles and APCs for all journal categories. TROPICAL MEDICINE, had the highest median number of OA articles (120.5 articles) and the lowest median APC.

Correlations Between Journal Influence-Related Indicators and APCs

1. Correlations Between Journal IF and APCs

Journals without IF data (five journals) were removed, and Pearson correlation analysis was conducted on 2,032 journals. The coefficient for journal IF value and APC was .168 (p < .001), which was significant.

Because some journals had extremely high IF values, the journals were divided into two groups. For the > 10 group (57 journals), the correlation

coefficient was .025 (p = .854), which was nonsignificant. By contrast, for the < 10 group (1,975 journals), the correlation coefficient was .312 (p < .001), which was significant. APC increased with IF, however, when the IF value exceeded 10, no reasonable explanation could be provided for the APC growth.

2. Correlations Between Journal Ranking and APC

All journals (i.e., 2,619, which included journals counted more than once) the correlation coefficient was −.349 (p < .001), which was significant and indicated that journal ranking and APC were negatively correlated. In other words, higher APCs droved by better journal ranking.

Quartile analyses indicated that for journals ranked in Q1 and Q4, the correlations between journal ranking and APC were significant (achieving a significance level of p < .01). By contrast, for Q2 and Q3 journals, no significant correlations were observed. Table 1 presents the correlations between journal ranking and APC.

Table 1 Correlations Between Journal Ranking and APC

Ranking distribution	Number of journals published	Correlation
Overall	2,619	–.349** (.000)
Q1 (1-25%)	671	–.119** (.002)
Q2 (26-50%)	725	–.038 (.309)
Q3 (51-75%)	719	–.017 (.651)
Q4 (76-100%)	504	–.175** (.000)

Note: Journals included those counted more than once; numbers in parentheses are p values.
**correlation level of p < .01 (two-tailed).

3. Correlations Between II and APCs

Pearson correlation analysis for journal II value and APC was .227 (p < .001), achieving significance. Because some journals had high II extreme values, to properly identify the correlations between journal II values and APCs charged, the journals were divided into two groups. For the > 1 group (446 journals), the correlation coefficient was .142 (p = .003); the < 1 group (1,591 journals), the correlation coefficient was .402 (p < .001), both have significant.

The II value < 1 group had a stronger II value–APC correlation. By contrast, when the journal II value was greater than one, the correlation between journal II value and APC charged (i.e., the rule of APC growth) became less visible.

Discussion and Suggestion

Through the two aspects of journal publication characteristics and influence to explore the correlation with APC price. The results of the study found that publication characteristics and APC only showed a low correlation, which further showed that journal publisher may still regard journal influence as the main factor when setting APC.

We suggest that future studies investigate library, publisher, and sponsor unit personnel's awareness of, adaptive strategies for, and views on APC mechanisms to help academic researchers achieve a more in-depth understanding of the publishing mechanism of APC.

ROMANIZED & TRANSLATED REFERENCES FOR ORIGINAL TEXT

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Journal of Educational Media & Library Sciences
JoEMLS

教育資料與圖書館學　59 : 2 (2022) : 201-231
DOI:10.6120/JoEMLS.202207_59(2).0014.RS.AM



主題相似性估計與其在主題建模穩定性測量之應用

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摘要

主題建模的穩定性測量針對相同文本集合以及在相同起始條件下，同一建模方法產生的模型能夠具有相似主題的程度。由於估計主題之間相似性的方法是主題建模穩定性測量的基礎，並且「主題對齊」是這項測量的關鍵步驟。本研究首先根據經由主題對齊之後獲得配對主題相同的比例，比較不同相似性估計方法，並觀察各種方法的相似性分數分布。最後，也分析主題數目對於穩定性測量的影響。本研究使用的主題建模方法是常用的潛在狄利克里分配（LDA）主題建模，並從 PTT BBS Book 板上約30,000篇發文產生分析的模型。研究結果觀察到這些相似性估計方法配對主題相同的比例很高，但在配對主題上的相似性分數則有不同的分布，同時也發現隨著主題數目增加，主題建模的穩定性下降。

關鍵詞： 主題建模，潛在狄利克里分配（LDA），穩定性測量，主題相似性估計，主題對齊

緒　論

主題建模（topic modeling）假設要分析的文本中包含一個或多個主題，而主題是由一組語意相關的詞語依據特定的比例構成，其目的便是利用數學或統計方法，找出文本集合中蘊含的主題結構。利用主題建模方法可以快速而有效率地協助分析文本內容，並且具有可以處理大量文本資料的可擴展性（scalability），已經愈來愈廣泛應用於各種文本分析的問題上，例如確認與檢索某些特定主題的文件；探討大眾傳播媒體（Jacobi et al., 2016）、政治演說（Quinn

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此篇文章之同儕評閱意見報告（Open Point）及導讀簡報（InSight Point）請至本刊網站查閱
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et al., 2010）或社群媒體（Elgesem et al., 2015）上討論的公共議題；追蹤新聞事件的發展（Kim & Oh, 2011）；分析網路評論上使用者對於產品各項設計與功能面向的評價與口碑（Tirunillai & Tellis, 2014）；發現電影等娛樂產品的心理主題特徵（psychological thematic features）與消費之間的關係（Toubia et al., 2019）；甚至應用在軟體工程（software engineering; Agrawal et al., 2018; Panichella et al., 2013; Sun et al., 2016）、研究評鑑（research evaluation; Nichols, 2014）上。以技術來說，機率潛在語意分析（probabilistic latent semantic analysis，簡稱pLSA；Hofmann, 1999）、潛在狄利克里分配（latent Dirichlet allocation，簡稱LDA；Blei et al., 2003）都是常見的主題建模技術，近年來也有將非負矩陣分解（nonnegative matrix factorization，簡稱NMF）技術應用於主題建模（Wang et al., 2012）。

以目前來說，LDA是最為研究者熟知、而且廣泛應用於各領域的主題建模技術（Lancichinetti et al., 2015）。LDA產生的主題模型是一種機率式生成模型（a generative probabilistic model）。假定所有的文件所成的集合中共有K個主題，將每一筆文件視為是由這K個主題依據特定的機率分布混合組成。每一個主題則由所有詞語出現在主題上的機率來表示（Blei et al., 2003），與主題相關的關鍵詞語具有較大的機率；反之，不相關的詞語的機率則相當小。所以主題模型包括兩組機率分布：所有文件上的主題機率分布與所有主題上的詞語機率分布，前者形成的矩陣在主題建模技術中稱為θ，而後者的矩陣則稱為ϕ。主題建模時，給定應用的文件集合和主題的數目K以及產生Dirichlet分布所需的先驗參數α和β，LDA演算法根據α和β隨機產生起始的θ和ϕ。然後再根據當前的θ和ϕ，將輸入文件的詞語分配到每個主題上，重新推導出更精確的θ和ϕ。反覆上述的訓練過程，使得文件的產生有最大的可能性。然後使用者便可以利用這兩組機率分布做為特徵，解讀文件內可能包含的主題以及主題可能的意義。為了更加有效地應用在探索和描述文本內容的主題結構，研究者除了探討與發展主題建模的應用領域之外，很多研究針對LDA的主題模型架構，提出各種不同的衍生模型，如關聯主題模型（correlated topic models，簡稱CTM；Blei & Lafferty, 2007）、動態主題模型（dynamic topic models，簡稱DTM；Blei & Lafferty, 2006）、階層式狄利克雷歷程混合模型（hierarchical Dirichlet processes，簡稱HDP；Teh et al., 2006）等等。另一方面，則是從LDA的模型品質著手，嘗試找出更有效、更穩定描述文本集合的模型。這些品質指標最為研究者所認識的是用來表示主題模型的文本預測能力的對數概似值（log-likelihood）和複雜度（perplexity; Griffiths & Steyvers, 2004），以及表示主題模型之可解釋性（interpretability）的主題協調性（coherence; Röder et al., 2015）。穩定性（stability）也是近來主題建模研究的議題之一（可參見Agrawal et al., 2018, 3.4. LDA, Instability and Tuning; Maier et al., 2018, Appendix）。

穩定性是同一的演算法在相同的輸入資料下，每一次執行能夠得到相同結果的測量指標。穩定性高的主題建模方法便是針對相同文件集合，在相同的主題數目（K）和先驗參數（α和β）等條件下，每次產生的各個模型上能夠有相似的主題。換句話說，產生的每一對模型之間有很高的一致性（agreement）。但是一般LDA的建模結果是不確定的（nondeterministic），在相同的條件下，某幾個模型上出現的主題可能並沒有出現在另外幾個模型中。如此一來，在應用主題建模技術分析文本集合的主題結構時，將無法確定此次建模所得到的主題是穩定或偶然出現的（Koltcov et al., 2016）。僅憑某一次建模所得到的主題模型做為文本內容分析的結果，可能會得到錯誤結論（Agrawal et al., 2018），造成分析結果的信度（reliability）有待商榷，影響主題模型的有用性（Maier et al., 2018）。本研究的目的便是針對LDA主題建模穩定性的測量進行分析。

主題建模穩定性的測量方法有很多，本研究依據De Waal與Barnard（2008）、Greene等（2014）、Belford等（2018）使用的主題建模穩定性測量架構進行研究。此測量架構的過程說明如下：首先在相同的輸入資料（文件集合、主題數目與先驗參數）下，重複進行多次主題建模，產生多個模型。然後，計算任何兩個模型間的一致性分數（agreement score），如果模型之間大多有較高的一致性，也就是主題模型上的主題幾乎都可以在另一個模型上找到相似的主題時，表示主題建模的穩定性較高。因此，將所有一致性分數的平均值做為主題建模穩定性的測量值。例如在主題建模時共產生M個模型，假設第i和j個模型間的一致性分數為$agreement_{ij}$。穩定性的測量值可表示為式(1)的形式，

$$stability \stackrel{\text{def}}{=} \frac{\sum_{i=1}^{M}\sum_{j=i+1}^{M} agreement_{ij}}{M(M-1)/2} \quad (1)$$

計算兩個模型之間的一致性分數則先找出這兩個模型中相似的主題配對，然後以配對的相似性分數平均值做為一致性分數。找出模型之間彼此最佳主題配對組合的步驟稱為主題對齊（topic alignment; Belford et al., 2018; De Waal & Barnard, 2008; Greene et al., 2014）。式(2)以數學形式表達上述想法，

$$agreement_{ij} \stackrel{\text{def}}{=} \frac{\sum_{k=1}^{K} sim(t_{ik}, t_{j\pi(k)})}{K} \quad (2)$$

在式(2)中，t_{ik}表示第i個主題模型的第k個主題，$t_{j\pi(k)}$則是t_{ik}經過主題對齊後在第j個主題模型上配對到的主題，$sim(t_{ik}, t_{j\pi(k)})$表示這個配對的相似性分數。如果經過主題對齊後，兩個模型在最佳配對組合內的主題之間大多具有較高的相似性分數，這兩個模型之間便有較高的一致性。

在上述主題建模穩定性的測量架構中，由於估計兩個主題t_{ik}和t_{jl}之間的相似性分數$sim(t_{ik}, t_{jl})$是測量的基礎，因此本研究將從主題相似性估計方法的分

析與比較開始。可用來估計主題之間相似性分數的方法很多，例如，Jaccard分數（簡稱JAC）、KL散度（Kullback-Leibler divergence，簡稱KLD）、JS散度（Jensen-Shannon divergence，簡稱JSD）和餘弦測量（cosine measure，簡稱COS）等等，不同的估計方法使用不同的主題特徵資訊，例如部分的關鍵詞語集合或詞語的出現機率，估計的方式也不相同。上述穩定性測量架構是建立在主題對齊獲得的主題配對組合上，如果配對相同的情形很高，則兩種不同相似性估計方法在穩定性測量的應用上將有相近的效果。因此，本研究則認為比較不同相似性估計方法時，應觀察不同相似性估計方法在最佳主題配對組合上配對相同的比例，瞭解不同方法應用於計算穩定性上是否有差異。此外，配對組合中可能包含相似性分數較高的配對，也可能包含分數較低的配對，本研究將觀察與比較各種相似性估計方法在配對主題上的相似性分數分布。

本研究並將討論主題數目對於穩定性的影響。主題數目（K）是主題建模相當重要的參數，目前有關主題建模穩定性的研究大多只有測量一種主題數目下的穩定性，只有Greene等（2014）、Ballester與Penner（2022）曾針對不同主題數目如何影響穩定性進行探討。但Ballester與Penner（2022）所使用的穩定性測量方法主要針對應用於文件叢集（document clustering）的主題建模方法上，所使用的概念不同於本研究使用的主題建模穩定性測量架構。Greene等（2014）認為較少的主題數目，將使得每個主題涵蓋的概念較大，出現機率分散在多個詞語上，可能出現的關鍵詞語種類較多；反之，主題數目增加時，每個主題的範圍縮小，主題上關鍵詞語彼此的相關性增加，但主題數目過度增加時，將使得主題的範圍過度狹隘，使得出現機率集中在少數詞語上（Greene et al., 2014）。由於主題建模的過程是反覆根據模型參數隨機地重新分配進行調整，因此可以推測主題數目將會對於主題建模的穩定性造成影響。但Greene等（2014）的研究使用的文本資料都已經有明確的主題，例如新聞語料庫上的版面資訊，而且主題數目都相當小。因此本研究將以主題不明確且數量較多的文本資料討論這個問題。

綜上所述，本研究將進行以下的觀察與分析：

㈠不同相似性估計方法在最佳主題配對組合上配對相同的比例，

㈡各種相似性估計方法在配對主題上的相似性分數分布，

㈢主題數目對於主題建模穩定性的影響。

本論文的章節結構如下：本節說明研究的動機與目的，簡要說明主題建模穩定性的測量方法與本研究將探討的問題；接下來，將對有關主題建模穩定性測量的研究以及其中最重要的主題相似性估計方法進行文獻回顧；再接下來說明研究中使用的文本資料、主題建模、主題相似性估計方法與穩定性的測量方法；最後的兩節分別是研究結果與結論。

二、相關研究

本節首先說明過去有關主題建模穩定性以及測量方法的研究，然後討論對穩定性測量相當重要的主題相似性估計方法。

㈠ 主題建模的穩定性以及測量方法

利用LDA主題建模程式進行文本內容分析的研究大多假定建立的主題是真實且一致的，結果具有相當的可重複產生性（reproducibility）。因此，這些研究除了調整模型的主題數目以外，對於產生主題在文件上的機率分布和詞語在主題上的機率分布的先驗參數α和β，往往採用程式預設的參數值，而且通常只採用一次建模所得到的結果，很少重複執行多次建模（Belford et al., 2018; Maier et al., 2018）。然而實際上，即便使用相同參數以及相同文本，每次建模產生的主題模型往往會有一些差異。這種不穩定的情形導致應用LDA主題建模在自動內容分析的有用性在近年越來越受到質疑（Belford et al., 2018; Chuang et al., 2015）。

根據以上的說明，測量主題建模的穩定性需要經由計算多次建立的主題模型之間的一致性分數，如果多個結果模型彼此一致的話，主題建模的結果便可認為是比較穩定的。比較這些模型的一致性有兩種做法：一種是Maier等（2018）與Belford等（2018）所建議的做法：在相同的參數下，對相同文本執行M次主題建模，獲得M個模型，然後計算全部$M(M–1)/2$對模型之間的一致性分數，再進行平均或以其中位數做為主題建模穩定性的測量值；另一種方法則是由Greene等（2014）提出，利用全部文件訓練、較完整的模型做為參考模型，以參考模型為主，計算它與其他（M-1）個只取部分文件訓練、較弱模型之間的一致性分數，再進行平均或取中位數。

既然主題建模的初始化與建模過程都是隨機的，每次建模所得到的主題次序與內容不大可能完全相同。在模型A上編號為k的主題可能與模型B上同樣編號k的主題相差很大，但與編號k'的另一個主題較相似。這種情形將造成計算兩個模型之間一致性的問題。因此，De Waal與Barnard（2008）、Greene等（2014）、Belford等（2018）建議在計算兩個主題模型的一致性分數時，可先將兩個模型之間主題的相似性分數輸入匈牙利演算法（Hungarian algorithm; Kuhn, 1955）進行主題對齊，一對一匹配兩個模型上相似的主題，獲得兩個模型的最佳主題配對組合。然後再以最佳配對組合內的主題配對估計這兩個模型的一致性分數。以下簡要說明上述研究應用匈牙利演算法進行主題對齊並計算一致性分數的方式，附錄中將提供匈牙利演算法的程序與一個簡單的主題對齊範例。

De Waal與Barnard（2008）提出根據兩個模型在文件上主題出現機率分布（θ）計算主題模型一致性的方法。他們建議先估計兩個模型之間主題的相似

性，然後將兩個模型共有K^2對的主題相似性分數輸入匈牙利演算法進行主題對齊，找出兩個模型的最佳配對組合。如果主題建模的方法穩定，同一筆文件在不同次的建模結果中彼此應具有相似的主題。因此，他們將主題視為文件的特徵，兩個模型在同一文件上的主題出現機率分布則是文件的兩組特徵值。當兩個模型進行主題對齊之後，可以利用所有文件上的主題機率分布，比較兩組特徵值的相關性，以相關性的高低表示模型之間一致性的大小。

Belford等（2018）和Greene等（2014）都以每一個主題上前T個出現機率較高的詞語集合代表各個主題。在估計兩個模型之間所有主題的相似性分數之後，將所有相似性分數輸入匈牙利演算法，找出兩個模型最佳的主題配對組合。兩個研究都將模型之間的一致性定義為最佳配對組合內每一對配對JAC之平均值。

Yang等（2016）首先利用匈牙利演算法進行主題對齊，然後將產生的主題配對組合應用在主題模型之間一致性的測量。他們提出三種主題模型一致性分數的測量方法：第一種方法先將要進行一致性測量的兩個主題模型分別應用於文件主題指定（document topic assignment），也就是文件中出現機率最高的主題。如果同一文件在兩個模型中指定的主題分別是主題對齊產生的配對主題，文件的主題指定便是一致的，而文件集合內主題指定一致的文件比例愈高，這兩個模型之間的一致性分數便愈高。第二種方法與Greene等（2014）、Belford等（2018）同樣使用每一個主題上前T個出現機率較高的詞語集合代表各個主題，但Yang等（2016）不使用配對主題JAC之平均值，而是將兩個模型的一致性定義為它們之間所有配對主題上詞語相同的比例，當配對主題的詞語相同比例愈高，兩個模型便愈一致。第三種方法則將主題模型應用在文件上每一個詞語的主題指定（token topic assignment），也就是決定文件上每一個詞語為主題模型上的哪一個主題，將文件集合內主題指定為同一對配對主題的詞語之比例視為主題模型之間的一致性。

使用匈牙利演算法對兩個模型中的主題進行主題對齊，其運算複雜度為O（K^3），所以也有其他的研究採用較簡單的方法來計算主題模型的一致性。Maier等（2018）將兩個主題模型的一致性定義為完成配對的主題數量佔模型主題數目的比例。並定義某一個主題t_{ik}與另一個主題t_{jl}完成配對的條件為t_{ik}是其所屬模型中與t_{jl}相似性分數最高的主題，而且其分數超過0.7。

其他研究則提出不需先對模型進行主題對齊的穩定性測量方法。Belford等（2018）關於主題建模穩定性的研究中，除了前述利用匈牙利演算法對齊模型主題計算模型一致性分數的方法之外，另外提出其他兩種測量穩定性的方法：第一種方法對主題模型的每個主題，選出T個出現機率最高的關鍵詞語，然後以所有主題的關鍵詞語集合做為模型的代表特徵。主題模型對另一個模型的差異比率則定義為兩者關鍵詞語集合的集合差（set difference）大小佔所有可能主題

關鍵詞數目（$K \times T$）的比率。如果兩個關鍵詞語集合完全相同，這對模型的差異比率為0；如果完全不同，差異比率為1。計算出每一對模型的差異比率後，再以差異比率的平均值做為主題建模穩定性的測量值。如果所有模型的差異比率平均值接近0，表示建模的結果相當穩定。

Belford等（2018）的另一種方法利用經常用於測量叢集一致性（clustering agreement）的正規化交互資訊（normalized mutual information; Strehl & Ghosh, 2002）估算兩次建模結果之間的一致性。他們簡化主題建模方法所具有的機率叢集（probabilistic clustering）特性，只使用每個文件的主要主題（dominant topic），也就是該文件上出現機率最大的主題，視為一種將文件進行叢集分析（cluster analysis）所得到的劃分（partition）[1]。在第一次建模結果中，某一組具有相同主要主題的文件，如果在第二次結果也具有相同的主要主題，也就是兩次叢集的劃分結果相同。如果大多數相關的文件在兩次建模都具有相同主要主題的情形，此時便可獲得較高的正規化交互資訊，而可認為兩個模型相當一致。因此，將主題建模的穩定性定義為每一對模型之間正規化交互資訊的平均值。

Agrawal等（2018）利用主題中出現機率最高的前T個詞語代表主題，利用主題上的詞語在多次建模結果中重複出現的次數測量穩定性。當在M次的建模結果中，對於某一個主題，假定能發現與其有t個詞語相同的主題共有m次時，這個主題在t個詞語時的重複比例被定義為m/M。Agrawal等（2018）將整個模型在t個詞語時的穩定性分數定義為每個主題重複比例的中位數。在比較各種主題建模方法的穩定性時，將每種方法各產生M次的訓練結果，計算t從1到T個詞語時的穩定性分數。大抵來說，隨著t增加，穩定性分數會降低，但比較穩定的主題建模方法的分數下降程度較小，也就是主題中包含較多重複出現的詞語。

Ballester與Penner（2022）探討與比較LDA、NMF和Doc2Vec三種主題建模方法[2]的統計強健性（statistical robustness）、描述力（descriptive power）和反映真實（reflect reality）等三種品質，他們並認為主題建模方法提供了比其他文件叢集方法更好的文件相似性計算，因此在比較主題建模方法的品質時，應該著重其在文件相似性的計算上。Ballester與Penner（2022）說明統計強健性的意涵為「在相同資料上，以相同參數執行相同建模應該產生相同或至少極為相似的結果」，事實上便是本研究所探討主題建模時的穩定性。綜上所述，在測量某種主題建模方法的統計強健性時，先產生多個模型，然後計算每一對文件相似性分數在所有模型上的標準差（standard deviation），較大的標準差表示該對文件在

[1] Belford等（2018）所指之文件的主要主題也就是Yang等（2016）的文件主題指定結果。

[2] Doc2Vec利用類神經網路（neural network）的方式推導代表每個文件的特徵向量，稱為文件的嵌入（document embedding）。語意相似的文件，其嵌入之間的餘弦相似性較高。但因為無法解讀嵌入上的每一個元素代表的意義，嚴格來說，Doc2Vec並不能算是主題建模方法。

應用不同模型所得到的相似性分數有較大的差異。如果將所有成對文件的相似性分數標準差進行平均後，產生較大的數值，便表示這種主題建模方法並不是相當強健，也就是不穩定。Ballester與Penner（2022）建議文件相似性分數的計算，在LDA和NMF上可以利用文件的主題機率分布進行COS，Doc2Vec則可將COS應用在代表文件的嵌入（embedding）上。Ballester與Penner（2022）的研究指出，在三種主題建模方法中，Doc2Vec在各種主題數目下，相較於其他兩種方法，在強健性上都有不錯的結果；LDA則是在採用較多主題進行建模時較為強健，但在較少主題時並不理想；NMF則在主題數目增加時，有不佳的強健性。

㈡ 主題之間相似性估計方法

主題模型上包含的兩種資訊，文件上的主題出現機率分布θ和詞語在主題上的機率分布ϕ，都可以運用來估計主題之間的相似性分數。在使用θ進行估計時，主題可視為文件一種特徵表現。例如De Waal與Barnard（2008）建議兩個主題的相似性分數可定義為兩個主題在所有文件上出現機率的乘積總和。以兩個主題t_a與t_b為例，假定它們在D筆文件$d_1 \sim d_D$上的出現機率分別是$p_{1a} \sim p_{Da}$和$p_{1b} \sim p_{Db}$，De Waal與Barnard（2008）將它們的相似性分數定義為$\sum_{i=1}^{D} p_{ia} p_{ib}$。當兩個主題在各文件上的出現機率相似時，所估算得到的相似性分數較高。

另一方面，在運用ϕ估計主題之間的相似性時，可依據主題的代表特徵分為三類。下面以表1上的簡單例子說明上述三類代表特徵以及使用這些特徵的相似性估計方法。在這個例子中，詞彙中詞語的總數共有七個，分別是$w_1 \sim w_7$，t_a、t_b與t_c是三個要進行相似性估計的主題，表格上的數值則代表對應的詞語在主題上的機率。

表1　以詞語在主題上機率（ϕ）估計主題相似性的簡例

主題	w_1	w_2	w_3	w_4	w_5	w_6	w_7
t_a	0.09	0.15	0.10	0.02	0.25	0.18	0.21
t_b	0.22	0.18	0.03	0.19	0.17	0.05	0.16
t_c	0.09	0.12	0.08	0.10	0.33	0.07	0.21

1. 以ϕ上的機率值代表主題的特徵：將表上的主題t_a表示為[0.09, 0.15, 0.10, 0.02, 0.25, 0.18, 0.21]形式之特徵向量。利用詞語出現在主題的機率值代表主題的特徵，因此相似主題彼此有相似的機率分布。常見的相似性估計方法有KLD、JSD、Pearson相關係數、COS和折扣累積效益（discounted cumulative gain，簡稱DCG）等。以表1為例，如果採用JSD做為相似性估計方法，t_a與t_b的JSD分數約為0.09，t_a與t_c的分數則為0.03。因為JSD分數愈小，兩個機率分布便愈相似，所以t_a與t_c比t_a與t_b更相似。

2. 以ϕ上前T個機率值較高的關鍵詞語所形成的集合代表主題的特徵：假定取機率值較高的前四個關鍵詞語代表主題，表1上的主題t_a便可表示為$\{w_5, w_7, w_6, w_2\}$，而t_b與t_c則分別可表示為$\{w_4, w_2, w_5, w_7\}$和$\{w_5, w_7, w_2, w_4\}$。相似的主題上彼此應具有相似的關鍵詞語集合，這類的相似性估計方法包括JAC和Dice分數等。如果採用JAC做為相似性估計方法，雖然t_b與t_c的關鍵詞語在集合內次序不同，但兩者包含相同的關鍵詞語。因此，t_a與t_b和t_a與t_c的JAC都是0.6。
3. 以ϕ上所有詞語或前T個關鍵詞語的順序代表主題的特徵：這類的方法有Spearman等級相關係數、Kendall τ係數（Kendall's τ coefficient，簡稱KEN）和等級偏向重疊分數（rank biased overlap，簡稱RBO）。假定採用RBO做為相似性估計方法利用關鍵詞語的順序比較兩個主題的相似性，表1上的各個主題同樣取機率值較高的前四個關鍵詞語代表。此時，因為t_a與t_c上的關鍵詞語順序比較相似，其分數約為0.85，比t_a與t_b的分數0.27大。也就是t_a與t_c比t_a與t_b更相似。

Mantyla等（2018）、Kim與Oh（2011）以及Niekler與Jähnichen（2012）比較不同的主題相似性估計方法的相關研究。Mantyla等（2018）採用Spearman等級相關係數、JAC和RBO等多種方式估計主題之間的相似性，然後計算主題建模的穩定性測量。結果發現這些方法所得到的穩定性分數之間有很高的正相關性。Kim與Oh（2011）、Niekler與Jähnichen（2012）的研究雖然不是針對使用相同文本集合進行多次訓練產生的主題模型，但他們將主題相似性運用在不同時間區段所產生的主題模型，找出各個模型中相似的主題，追蹤主題在時間上的演化情形，也是主題相似性估計的應用。Kim與Oh（2011）比較JAC、KLD、JSD、COS、KEN和DCG等六種方式來估計前後時期兩個主題之間的相似性，以找出最相似的主題，做為新聞中持續出現的議題（issues）。在Niekler與Jähnichen（2012）的研究中，他們以每天的新聞建立主題模型，挑選出每天都出現的主題，然後應用了JSD、COS和Dice分數等三種方法估計兩個日期中所有主題之間的相似性。

㈢ 本節小結

從上述的文獻探討可觀察到目前在主題建模穩定性的測量方法中，較主流的測量架構是首先訓練出多個模型，然後針對每兩個模型計算其一致性分數，以所有一致性分數的平均值做為穩定性的測量值（Belford et al., 2018; De Waal & Barnard, 2008; Greene et al., 2014）。計算兩個模型之間的一致性分數時，由於每個模型上的主題次序與內容不大可能完全相同，因此關鍵步驟是進行主題對齊，找出兩個模型之間的最佳主題配對組合，然後再比對兩個模型應用於文件主題指定結果或估計配對主題的相似性。由於主題建模方法的應用不僅是瞭解目前文件集合內各文件具有的主題分布θ，更可進一步利用各主題上的詞語機

率分布ϕ去推論新進文件上的主題分布，且透過主題詞語機率分布，較容易解讀主題建模的結果，因此本研究將採用Belford等（2018）和Greene等（2014）使用的主題建模穩定性測量框架，並利用配對主題相似性的平均值計算模型之間的一致性分數。

另一方面，Belford等（2018）和Greene等（2014）以每一個主題上前T個出現機率較高的詞語集合來估計主題之間的相似性。相較於使用所有詞語的機率值或機率的大小順序，這種方式所使用的數據量相當少。僅使用主題詞語機率分布上少部分資訊來估計主題相似性，是否會對相似性的估計結果，甚至主題建模的穩定性測量結果產生影響，值得進一步探討。因此本研究將應用多種主題相似性方法於主題建模的穩定性測量，計算主題對齊產生配對結果相同的比例，比較各種相似性估計方法，並觀察這些方法在模型之間最佳主題配對組合上的相似性分數分布。

最後，目前只有Greene等（2014）以及Ballester與Penner（2022）等少數研究曾針對不同主題數目如何影響穩定性進行探討，但Ballester與Penner（2022）所使用的穩定性測量方法主要針對應用於文件叢集的主題建模方法上，而Greene等（2014）使用的文本資料都已經有明確的主題，且主題數目都相當小。因此本研究將使用主題不明確且數量較多的文本資料，分析主題數目對穩定性測量的影響。

三、研究方法

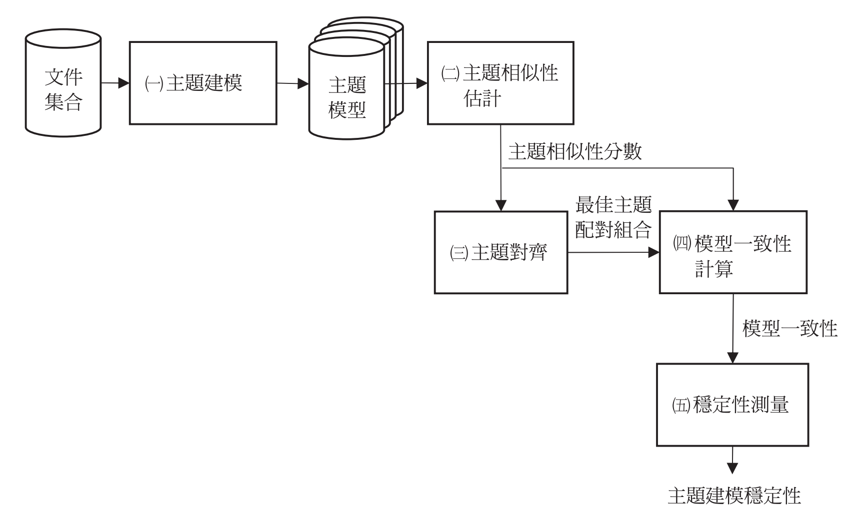
本研究在測量主題建模的穩定性時所採用De Waal與Barnard（2008）、Greene等（2014）、Belford等（2018）使用的主題建模穩定性測量架構，其過程如圖1所示：㈠對文本資料的集合，利用LDA主題建模程式，進行多次主題建模，訓練出M個模型；㈡估計每一對模型上各個主題之間的相似性；㈢利用這些相似性分數，經過主題對齊後，找出平均相似性分數最佳的主題配對組合；㈣以最佳配對組合上的相似性分數計算這一對模型的一致性分數；㈤將所有$M(M-1)/2$對模型的一致性分數進行平均，做為穩定性的測量值。以下說明本研究使用的文本資料、主題建模以及各種相似性估計方法，最後是主題模型一致性的計算與主題建模的穩定性測量。

㈠ 文本資料

本研究從批踢踢實業坊電子布告欄系統（PTT BBS）上蒐集估計主題建模穩定性的文本資料。本研究選擇PTT BBS書板（https://www.ptt.cc/bbs/book/index.html）上網友發布的文章，利用自行撰寫的程式蒐集發文內容，建立語料庫，蒐集的時間範圍自2009年1月起到2021年4月，共獲得32,895筆發文。

由於書板上發文內容主要以中文書寫，所以在進行主題建模前，需要先經

圖1　主題建模穩定性測量過程示意圖



過斷詞處理（word segmentation）。本研究採用中央研究院詞知識庫小組開發的ckiptagger（Li et al., 2020）做為斷詞系統，將輸入的發文內容切分為詞語的序列。同時，也將斷詞結果輸入ckiptagger的詞類標示（part-of-speech tagging）模組，標示出每個詞語對應的詞類。

要進行主題建模，可先建立建模用的詞典，彙整語料庫內所有文本資料出現的詞語，過濾較不重要的停用詞。本研究在過濾停用詞時，依據詞語的詞類和在整個語料庫上出現的總次數和發文數進行過濾，保留普通名詞、專有名詞、地方詞、名物化動詞與非謂形容詞等詞類的詞語，但刪除出現次數少於50次或出現發文數在總發文數1/10以上的詞語，共得到3,043種不同詞語。

最後建立建模用的文本集合。以詞典統計每筆發文上出現的詞語種類，選擇內容中至少包含五種詞語的發文，做為文本集合。最後集合內共計20,287筆發文，所有發文上出現的詞語總數為1,579,116個詞。

(二) 主題建模

將詞典與分析的文本集合以及設定的參數輸入主題建模，產生主題模型。本研究採用python上較多人使用的主題建模套件gensim（https://radimrehurek.com/gensim/），版本為3.6.0。但為了得到較佳的主題模型結果，在gensim上取用University of Massachusetts開發的主題建模軟體Mallet（MAchine Learning for LanguagE Toolkit, http://mallet.cs.umass.edu/）進行建模，使用的Mallet版本為2.0.8。

在本研究中，固定先驗參數α和β，針對不同主題數目（K = 5, 10, 15, …, 100），各建立20個模型[3]。對於模型數目的選擇上，需要足夠多的模型才能確認

[3] 主題建模所使用的先驗參數α設為50，β採用Gensim套件的預設值，訓練次數（iteration）也採用Gensim套件預設值1,000。

每次執行產生的模型主題是否不穩定，但又因為需要估計每一對模型的主題相似性，其複雜度為$O(M^2)$，模型數目過多，也會影響研究的效率。本研究參考Mantyla等（2018）的研究設計，將模型數目設為20。這些主題模型將用來測量模型間主題的相似性，分析與比較不同的相似性估計方法以及探討主題數目對主題建模穩定性的影響。

㈢ 相似性估計方法

根據前面對於相似性估計方法的探討，主題的特徵可以使用：1.詞語的出現機率分布，2.機率較高的關鍵詞語集合，3.詞語的出現機率順序等方式代表。本研究從各類的代表特徵中選出六種方法應用於主題建模的穩定性測量，使每種主題特徵類型至少有一種方法。本研究並調整各種方法輸出結果，使得所有的估計範圍在0與1之間，並且主題之間愈相似者，其估計分數愈大。以下說明這六種方法以及本研究如何調整與應用。

1. JS散度（JSD）

JSD可以估計兩個機率分布之間的差異，是以KLD為基礎的延伸，目的是為了改善KLD不對稱、計算分數的範圍不定（有可能為無限大）等問題。JSD的範圍在0與1之間，如果兩個機率分布愈相似，則它們之間的JSD愈小（Kim & Oh, 2011）。因此，當我們以詞語的機率分布分別代表主題，假定第i個模型的第k個主題t_{ik}和其在第j個模型上第l個主題t_{jl}的詞語機率分布分別是ϕ_{ik}和ϕ_{jl}，利用JSD估計這兩個主題的相似性分數$sim_{JSD}(t_{ik}, t_{jl})$時，可以定義為1減去它們之間的JSD分數$JSdiv(\phi_{ik}||\phi_{jl})$，也就是$sim_{JSD}(t_{ik}, t_{jl}) \stackrel{\text{def}}{=} 1 - JSdiv(\phi_{ik}||\phi_{jl})$。

2. 正規折扣累積效益（NDCG）

DCG是一種排序品質的測量方法，經常用來評估搜尋引擎演算法的有效性（Järvelin & Kekäläinen, 2002）。由於搜尋引擎的檢索應該盡量將相關性高的答案排在結果前列。所以當評估搜尋引擎時，其成效的計算方式是將所有預測結果與正確答案相比的相關性分數除以正確答案所在位置的對數值，藉此減少後列正確答案的重要性，最後將這些經過折扣的分數加總起來。在本研究的應用上，考慮為了使相關性分數估計的結果範圍在0與1間，將採用正規折扣累積效益（normalized discounted cumulative gain，簡稱NDCG）。並且因為NDCG的計算並不是對稱的，也就是$\mathrm{NDCG}(\phi_{ik}, \phi_{jl}) \neq \mathrm{NDCG}(\phi_{jl}, \phi_{ik})$，所以將主題$t_{ik}$與主題$t_{jl}$的相似性分數$sim_{NDCG}(t_{ik}, t_{jl})$定義為$(\mathrm{NDCG}(\phi_{ik}, \phi_{jl}) + \mathrm{NDCG}(\phi_{jl}, \phi_{ik}))/2$，使其具備對稱性。

3. 餘弦測量（COS）

COS以兩個向量之間夾角大小（Maier et al., 2018），評估這兩個向量方向的相似度，如果這兩個向量的方向完全相似，COS的測量結果為1，如果完全相反，測量結果為–1。因此，在測量主題t_{ik}與另一個模型的主題t_{jl}的相似性分數

$sim_{COS}(t_{ik}, t_{jl})$時，可以將它們的詞語機率分布$\phi_{ik}$和$\phi_{jl}$視為是特徵向量，利用COS進行估計，也就是$sim_{COS}(t_{ik}, t_{jl}) \stackrel{\text{def}}{=} Cos(\phi_{ik}, \phi_{jl})$。雖然COS的結果範圍在–1到1之間，但因為$\phi$上詞語的機率值都是大於或等於0，所以相似性分數$sim_{COS}(t_{ik}, t_{jl})$的值範圍在0與1之間。

4. Jaccard分數（JAC）

JAC經常使用於估計兩個集合的相似性，其計算方式為兩個集合的交集內的元素個數除以聯集內的元素個數。如果兩個集合內的元素相當相似時，它們的交集和聯集中的元素都和它們相似，所以其JAC接近1；反之，兩個集合內的元素相當不同時，它們交集內的元素個數比起聯集內的元素個數少很多，此時的JAC接近0。以出現機率較高的前面數個關鍵詞語所形成的集合代表主題時，便可採用JAC估計任何一對主題的相似性分數（Belford et al., 2018）。例如主題t_{ik}與主題t_{jl}的前T個機率最高的詞語所成的集合分別是R_{ik}與R_{jl}，估計相似性分數$sim_{JAC}(t_{ik}, t_{jl})$，可以定義為$Jaccard(R_{ik}, R_{jl})$。本研究參考Belford等（2018）的研究設定，選用前10個機率最高的關鍵詞語所成的集合代表主題，也就是$T = 10$。

5. 等級偏向重疊分數（RBO）

正如先前在相關研究的討論，利用JAC估計兩個主題的相似性分數只考慮兩個主題的關鍵詞語的重疊性，並沒有考慮詞語對主題的重要性，而這樣的重要性反應在詞語在主題上的機率以及其順序。RBO可以考慮關鍵詞語在主題上的重要性，使得機率較大的詞語在計算相似性分數時能夠有比較大的影響力（Webber et al., 2010）。RBO的結果範圍在0與1之間，如果RBO分數為0，表示這兩個主題上的關鍵詞語完全不同；如果RBO分數較大，表示這兩個主題的關鍵詞語與其重要性順序都很接近（Mantyla et al., 2018）。因此，本研究將相似性分數$sim_{RBO}(t_{ik}, t_{jl})$定義為$RBO(R_{ik}, R_{jl})$。與JAC相同，本研究選用前10個機率最高的詞語所成的集合代表主題，但需要注意的是輸入$RBO(R_{ik}, R_{jl})$的R_{ik}與R_{jl}上的每一個詞語則必須按照它們在主題上的機率排序。

6. Kendall τ係數（KEN）

KEN是用來估計兩個數列之順序關聯性的相關係數，是一種無母數（non-parametric）統計方法。KEN計算某一個數列上的資料項目與其他項目的相對順序關係在另一個數列上是否能夠維持的個數，當其相對順序關係都能夠保持時，它們的KEN值為1，如果都無法保持時，它們的KEN值為–1。本研究在估計主題t_{ik}與主題t_{jl}的相似性分數$sim_{KEN}(t_{ik}, t_{jl})$時，基於詞語機率分布$\phi_{ik}$和$\phi_{jl}$上的機率值估計兩個主題上詞語之順序關聯性的相關係數，也就是$Kendall(\phi_{ik}, \phi_{jl})$。但是KEN的結果範圍在–1與1之間。本研究將小於0的值都調整為0，使相似性分數$sim_{KEN}(t_{ik}, t_{jl})$的值範圍在0與1之間。

這六種方法的前三項（JSD、NDCG和COS）都是根據所有詞語的機率做為主題特徵，JAC和RBO則是選取部分機率較高的關鍵詞語集合代表主題，其中RBO還考慮詞語的機率順序，最後KEN則是以所有詞語的機率順序做為代表主題的特徵。

㈣ 主題模型一致性計算與主題建模穩定性測量

在估計兩個模型之間的所有相似性分數之後，將這些分數輸入匈牙利演算法，進行主題對齊，產生最佳主題配對組合。在獲得最佳主題配對組合之後，本研究將計算配對結果相同的比例，比較各種相似性估計方法，並觀察這些方法在模型之間最佳主題配對組合上的相似性分數分布。

最後，將每一對最佳主題配對的相似性分數進行平均，做為這兩個主題模型之間一致性分數，並以每一對主題模型之間一致性分數的平均值做為穩定性的測量值。本研究將分析主題數目對穩定性測量的影響。

四、主題建模穩定性的測量結果分析

㈠ 不同相似性估計方法之間主題配對相同的比例

穩定性測量的目的是評估在相同起始條件下，主題建模方法每次產生模型具有相似主題的程度，換言之，在對兩個模型進行主題對齊後，模型上大多數的主題能否配對到最相似的主題是穩定性測量的重要因素。因此，如果不同方法在主題對齊後獲得近似的最佳配對組合，表示這些方法應用在穩定性測量上有相近的效果。本研究針對LDA主題建模在相同起始條件下產生的20個主題模型，統計六種方法中配對結果相同的方法數量。由於研究時程與篇幅所限，目前只將主題數目設定為25，未來可進一步觀察不同主題數目下的主題配對相似性分數分布。結果如表2，左欄是主題對齊配對結果相同的方法數量，右欄則是該類型配對佔所有配對（4,750對[4]）的百分比。由於在本研究中，並沒有發現六種方法都不同的主題配對結果，因此便沒有呈現在表2上。

表2 25個主題的主題建模主題對齊結果相同的方法數量佔比

主題對齊配對結果相同情形	佔比（%）
六種方法都相同	76.99
僅其中五種方法相同	8.51
僅其中四種方法相同	8.59
僅其中三種方法相同	4.80
僅其中兩種方法相同	1.11

[4] 本研究針對LDA主題建模在相同起始條件下產生20個主題模型，總共190（20 × 19 / 2）對模型，每對模型產生25個主題配對，因此共有4,750對。

表2的配對結果可觀察到不同方法之間有很高比例獲得相同的情形。六種方法都相同的配對結果達到76.99%，四種或四種以上方法相同配對其佔比總和更達到94.09%（76.99% + 8.51% + 8.59%）。換言之，如果主題建模的穩定性測量目的是「在相同的主題數目（K）和先驗參數（α和β）下，針對相同文件集合的每次建模產生的主題應該是相似的」前提下，應用本研究探討的這幾種相似性估計方法可以達到大致相同的效果。

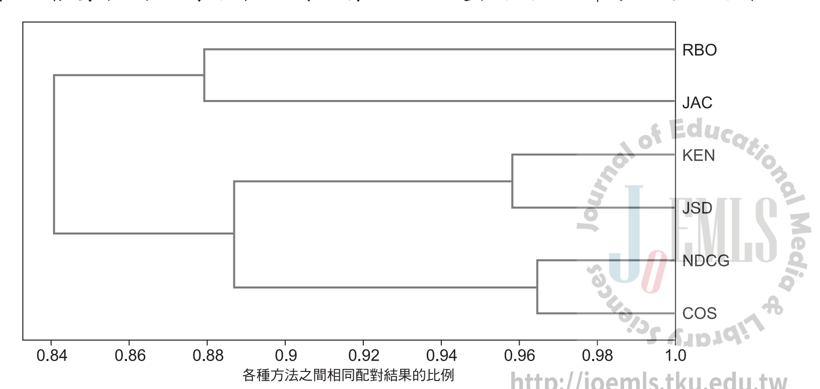
接下來，為了進一步瞭解不同的相似性估計方法之間哪些有更為接近的配對結果？本研究比較不同的方法，兩兩間具有相同配對結果的比例，比較結果呈現於表3。由於每對方法之間具有相同配對結果的比較結果是對稱的，因此表3只呈現比較結果的下半部，查看兩種方法具有相同配對結果的比例，可從表上兩種方法分別對應的行與列上取得所需的數值，例如查看COS與NDCG的比較結果，可從表上COS這一行與NDCG這一列上的數值取得。

表3　兩種相似性估計方法具有相同配對結果比例

	JSD	NDCG	COS	JAC	RBO
NDCG	90.88%				
COS	90.15%	96.48%			
JAC	85.81%	84.59%	84.06%		
RBO	84.67%	87.71%	86.80%	87.92%	
KEN	95.83%	89.68%	88.69%	85.07%	84.38%

在表3上，任何兩種方法具有相同配對結果的比例全都在84%以上，也就是任何兩種方法之間都有相當接近的配對結果。本研究並將表3的結果輸入完整連結叢集演算法（complete-linkage clustering algorithm），找出配對結果接近的方法。從圖2的叢集結果可以觀察到這些方法可分為兩組，第一組是COS、NDCG、JSD和KEN，第二組則是JAC和RBO，在同組內的各種方法有更接近的配對結果。前一組方法都是運用詞典中所有詞語在主題上的機率ϕ的數值或順序，後一組則都僅利用機率最大的前10個關鍵詞語上的資訊。這可能是造成這兩組方法之間有差異的主要緣故。

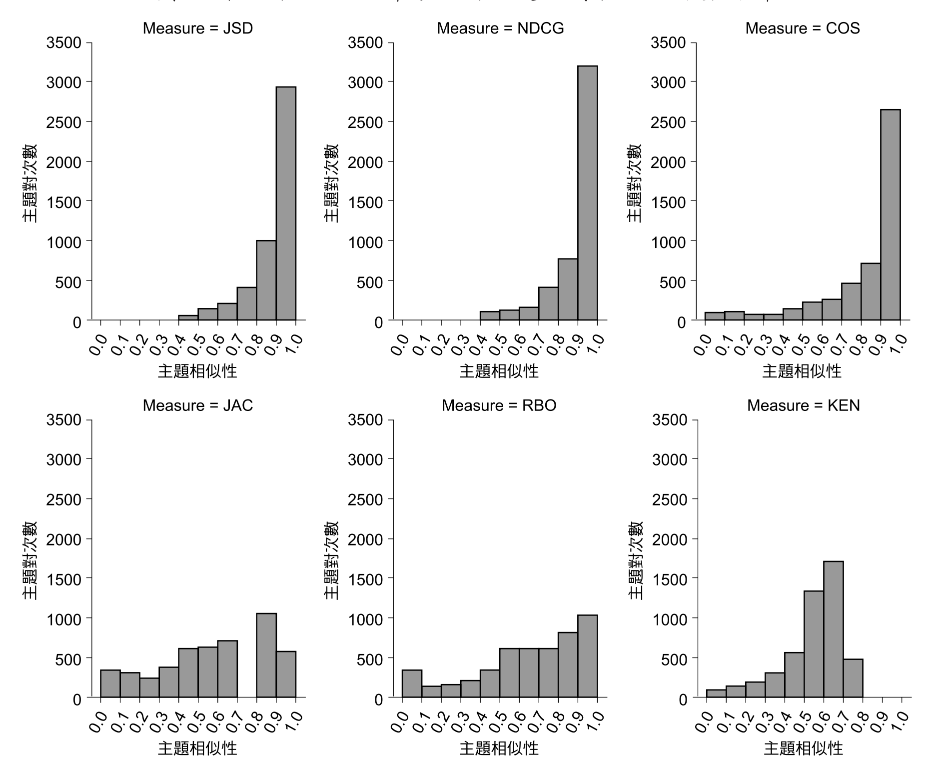

圖2　根據相同配對結果比例，將六種主題相似性估計方法分組結果



㈡最佳主題配對組合中各種相似性估計方法的分數分布

本研究接著觀察各種相似性估計方法在最佳主題配對組合上配對的分數分布，瞭解不同方法使用的主題特徵資訊與計算方式的差異。圖3表示各種估計方法的主題配對相似性分數分布。

圖3　各種相似性估計方法的主題配對相似性分數分布



以下依據代表主題的特徵方式，將六種相似性估計方法分為三組進行說明：

1. JSD、NDCG和COS

這三種方法都是利用所有詞語在主題上的出現機率作為特徵。JSD和NDCG的結果範圍相似，大約分布在0.4到1.0之間，且大部分配對主題之間都具有相當高的相似性分數，0.9到1.0之間分別有2,945對（佔全部4,750對主題的62.00%）與3,201對（67.39%），少於0.5的配對則各佔1.22%與2.29%。COS的分布範圍則在0.0到1.0之間，但大部分配對結果也有相當高的相似性分數，相似性在0.9到1.0之間有2,650對（55.79%），少於0.5的配對僅佔9.68%，且在0.0到0.1之間，佔全部的1.75%。

2. JAC和RBO

JAC和RBO都是採用關鍵詞語集合做為代表主題的特徵。相較於其他方法，這兩種方法的相似性分數分布較為分散，分布範圍在0.0到1.0之間，0.5

以上的配對分別佔全部的61.71%與76.11%。JAC所測量得到的主題相似性分數如果為1，配對主題彼此之間具有完全相同的關鍵詞語，RBO的主題相似性分數如果為1，配對主題除了具有完全相同的關鍵詞語外，關鍵詞語的順序也相同。在本研究中，JAC和RBO分別有566對（11.92%）與54對（1.14%）主題的相似性分數為1。在六種方法中，以這兩種方法產生最多相似性分數為0的情形。JAC和RBO分別有230對（4.84%）與235對（4.95%）的相似性分數為0。這個情形表示有些配對的主題有完全不同的關鍵詞語。

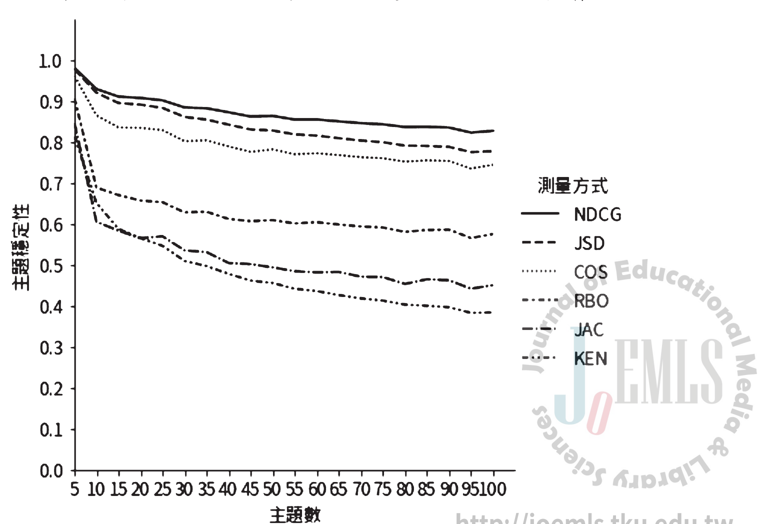
3. KEN

KEN的主題配對相似性分數範圍則在0.0到0.8之間，大部分分布在0.5到0.8之間，佔全部的73.56%，且其中最高只到0.76。在本研究中，相較於其他相似性估計方法，KEN根據某一個數列上的資料項目與其他項目的順序關係在另一個數列上能否維持的差異估計主題相關性，需要考慮詞典中每對詞語在配對的兩個主題上具有一致的出現機率順序。但每個主題上仍包含許多不相關且機率相當小的詞語，可能造成相似的主題卻無法有完全相同的順序，影響KEN的計算，因此所得到的相似性分數明顯地較其他方法為低。

㈢ 主題數目對於主題建模穩定性的影響

本研究以不同的主題數目（$K = 5 \sim 100$）各建立20個主題模型，然後測量主題建模在各種主題數目下的穩定性，圖4上的折線從上到下分別是在不同主題數目下運用NDCG、JSD、COS、RBO、JAC和KEN等方法測量得到的穩定性。在圖4上可觀察到不論何種估計方法，隨著主題數目增加，穩定性都有明顯下降的情形。並且在各種主題數目之中，以五個主題的主題模型最為穩定，

圖4　不同主題數目對於主題建模穩定性的影響



且其程度遠較其他數目的模型高出相當多。其原因可能是由於主題數目增加，使得模型中的主題概念範圍縮小，從而造成在主題中的詞語、順序和出現機率容易有變化的情形，可能讓有愈多的主題無法在另一個模型中比對到相當相似的主題，進而使得測量到的穩定性變差。

五、結　論

隨著LDA主題建模在文本分析的應用愈來愈廣泛，主題建模的穩定性測量也愈受到重視。在De Waal與Barnard（2008）、Greene等（2014）與Belford等（2018）使用的穩定性測量架構中，主題之間的相似性分數估計方法是測量主題建模穩定性的基礎，並且產生最佳主題配對組合的「主題對齊」是這個程序的關鍵步驟，然而過去的研究較少比較不同相似性估計方法對主題建模穩定性的影響，也缺乏針對主題對齊的結果進行探討。本研究採用PTT BBS書板約30,000筆發文做為分析的文本集合，並應用JSD、NDCG、COS、JAC、RBO和KEN等相似性估計方法，比較不同方法經由主題對齊之後產生配對結果相同的比例，並觀察各種相似性估計方法在配對主題上的相似性分數分布。最後並探討主題數目對於主題建模穩定性的影響。研究結果有以下的發現：

㈠本研究提出以具有相同配對結果的比例來比較不同的相似性估計方法在測量主題建模穩定性的效果，並發現本研究所探討的六種相似性估計方法配對結果相同的情形比例相當高。因此，在穩定性測量的應用上，例如本研究進行的主題數目對於穩定性的影響，各種方法大致上都有相同的效果。但本研究也發現方法上運用詞典中所有的詞語，或只利用少數的關鍵詞語仍會輕微影響配對結果是否相同。

㈡本研究觀察六種相似性分數估計方法，在經由主題對齊演算法產生主題配對組合上的相似性分數分布，目前主題建模的穩定性測量研究尚未有關於這方面的探討。在六種方法中，運用所有詞語在主題上的出現機率做為主題特徵的JSD、COS和NDCG等三種方法可以明顯地觀察到大部分配對有相當高的相似性分數。換言之，未來將可運用這三種方法搭配匈牙利演算法進行主題對齊，然後以較高的相似性分數選取出兩個模型中相似的主題。JAC和RBO兩種方法僅使用少數出現機率較大的關鍵詞語做為主題特徵，使得相似性分數的分布較分散，較難透過觀察分數決定主題是否配對到另一個模型上最相似的主題。但是利用JAC和RBO方法可發現配對中關鍵詞語完全相同或完全不同的主題。KEN的估計方式是根據每一對詞語在配對的兩個主題上是否維持一致順序，然而絕大多數詞語與配對的兩個主題並不相關。

㈢本研究發現，主題數目對於穩定性有很大的影響，使用不同的相似性估計方法都可觀察到，主題數目愈大時主題建模愈不穩定的現象。Greene等

（2014）認為，主題建模時較多的主題將造成較小的主題範圍，使得每次建模產生的主題多不相同，容易造成建模時的不穩定，本研究的結果與他們的推論相符合。然而本研究是針對LDA主題建模的穩定性進行探討，有別於Greene等（2014）針對NMF主題建模的研究。此外，Greene等（2014）的實驗假定文件僅有一個主題，且整個文本集合內的主題數目並不多；本研究則以較實際的主題建模應用為考量，假定分析的文件中可能包含多個主題，且考慮較大範圍的主題數目對主題建模穩定性的影響，較符合實際情況。

根據上述的研究結果，我們建議以下課題做為未來研究的方向：

㈠由於研究時程與篇幅的限制，本研究在進行主題建模的穩定性測量時，將模型個數固定為20，並在使用JAC和RBO兩種方法僅使用10個關鍵詞語做為主題特徵，未來可探討不同模型個數與關鍵詞語數目對穩定性測量的影響。

㈡目前在測量主題建模的穩定性時，大多根據估計的相似性分數計算模型之間的一致性，未來也許可以參考Maier等（2018）利用可能正確配對的主題數量佔比，發展適合直接解讀模型品質的測量方式，並找出各個模型中比較穩定的主題。例如整合不同方法的特性，先運用JSD、COS或NDCG等方法搭配匈牙利演算法進行主題對齊，確認兩個模型中較相似的主題，然後再利用JAC或RBO等方法選取模型中較穩定的主題或排除不穩定的主題。

㈢在運用主題建模進行文本分析時，主題數目是一個相當重要的輸入參數，主題數目決定了模型上主題彼此之間的差異與可解釋性（interpretability），主題數愈多，產生的主題具有愈加狹隘（narrow），而特定（specific）的意義，導致多個不同的主題可能具有相似的概念；反之，主題數目太少，將使得主題的意義廣泛，理應區分的概念被包含同一主題內（Maier et al., 2018）。過去已有相當多研究利用複雜度或主題協調性決定最佳的主題數目，甚至藉由人力檢視（Maier et al., 2018），Greene等（2014）提出利用穩定性發現最佳主題數目的概念。本研究則建議未來可嘗試運用與整合各種主題模型品質指標決定最佳的主題數目。

㈣最後，也是最重要的，在累積更多主題建模穩定性測量的經驗，對這項主題模型品質有較深入的瞭解後，可進一步嘗試發展提升主題建模穩定性的方法，使得相同輸入條件下每次產生模型上的主題盡可能相似，讓文本分析的結果具有高信度。目前已有一些有關這方面的研究，例如前述的Chuang等（2015）、Lancichinetti等（2015）、Koltcov等（2016）、Agrawal 等（2018）、Maier等（2018）和Mantyla等（2018）。

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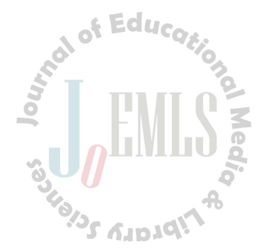
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附錄：匈牙利演算法及其在主題對齊的應用

以下首先說明匈牙利演算法的輸入、目的與步驟，接著以一個範例說明本研究利用匈牙利演算法進行主題對齊的方法與過程。

匈牙利演算法的輸入為一個行與列的數目都為K的矩陣。矩陣上的行與列分別代表要進行配對的兩組項目，矩陣上的元素則表示配對項目之間的差距。以第i行第j列上的元素為例，上面的值表示第一組的第i個項目與第二組的第j個項目之間的差距。匈牙利演算法的步驟如下：

Step 1：針對矩陣上的每一行，減去這行元素中的最小值。

Step 2：針對目前矩陣上的每一列，減去這列元素中的最小值。

Step 3：嘗試用最少的垂直線與水平線通過矩陣上所有為 0的元素。如果線的數目少於行數K，進行Step 4。否則，直接進行Step 5。

Step 4：找出整個矩陣中不是0的元素中的最小值m，將所有不是0的元素減去m。並且找出兩條線交叉上為0的元素，取代為m。然後，返回Step 3。

Step 5：選擇一個行與列的配對組合，使得每一行或每一列都只有一個0被選上。

本研究在計算兩個模型的主題以及每一對主題之間的相似性分數之後，將應用匈牙利演算法進行主題對齊。以附圖1(a)上的矩陣為例，表示兩個主題數目為5的模型上每一對主題之間的相似性分數，並且這些相似性分數的值在0到1之間。由於匈牙利演算法是計算兩組項目之間上最小差距總和的配對，但本研究希望取得兩個模型上相似性分數總和最大的主題配對，所以首先以1減去相似性矩陣上每個元素的值，轉換為差距矩陣，如附圖1(b)所示。假定第1個模型的第1個主題與第2個模型的第1個主題之間的相似性分數為0.29，這個值放在附圖1(a)相似性矩陣的第1行第1列上，當轉換為附圖(b)的差距矩陣時為1 – 0.29 = 0.71。

接著進行演算法的Step 1，找出每一行最小的元素，然後減去這個元素的值。例如第1行的元素為[0.71, 0.93, 0.08, 0.24, 0.85]，其中以0.08為最小的元素值，因此將這行上所有的元素減去這個值，結果為[0.63, 0.85, 0, 0.16, 0.77]。其他各行也是經過如此運算，結果為附圖1(c)上的矩陣。然後進行Step 2，將每列的元素減去該列的最小元素值，結果如附圖1(d)上的矩陣。

在演算法的Step 3，利用最少的線通過目前矩陣上所有出現0的元素。先選取上面有最多0的行或列開始，以線通過這個行或列。處理完後，如果矩陣上還有0尚未被通過，再選取目前上面有最多0的行或列，以線通過。重複進行上面的處理過程，一直到矩陣上所有的0都有線通過為止。以附圖1(d)上的矩陣為例，先選擇具有3個0的第3列，以線覆蓋此列。然後，再依序利用線通過第3行、第5行以及第1列和第5列。結果如附圖1(e)所示。目前矩陣上共有五條線，與行和列的數目相等，因此接著進行Step 5。

Step 5先選取只有單獨一個0的行，例如附圖1(f)上的第1、2和4等行。將這些行上的0所在列上其餘的0進行標記，例如根據第1行上的0，也就是(1, 3)（表示第1行、第3列，以下的表示方式與此相同）位置的0，標記同樣在第3列上其餘的0，包括(3, 3)和(5, 3)等位置上的0，附圖1(f)呈現這個處理的示意圖。如果有沒有被選取的行，便再

次選取除了已經標記的0之外，只有單獨一個0的行，並且將這些行上的0所在列上其餘的0進行標記，以上面的例子為第3行與第5行。反覆進行上面的處理過程，一直到所有的行被選取為止。

最後，矩陣上沒有被標記0所在的位置便是最佳的配對組合。在這個例子中，最佳配對組合包括(1, 3)、(2, 5)、(3, 2)、(4, 1)和(5, 4)等，如附圖1(g)所示。在這種配對情形下主題之間相似性分數的總和比其他任何配對組合的分數總和大，其總和為0.92 + 0.85 + 0.66 + 0.97 + 0.72 = 4.12。

附圖1　應用匈牙利演算法進行主題對齊之說明

	1	2	3	4	5
1	0.29	0.07	0.92	0.76	0.15
2	0.44	0.17	0.81	0.71	0.85
3	0.73	0.66	0.79	0.01	0.04
4	0.97	0.11	0.16	0.22	0.31
5	0.08	0.26	0.83	0.72	0.55

(a) 相似性矩陣

	1	2	3	4	5
1	0.71	0.93	0.08	0.24	0.85
2	0.56	0.83	0.19	0.29	0.15
3	0.27	0.34	0.21	0.99	0.96
4	0.03	0.89	0.84	0.78	0.69
5	0.92	0.74	0.17	0.28	0.45

(b) 轉成為差距矩陣

	1	2	3	4	5
1	0.63	0.85	0	0.16	0.77
2	0.41	0.68	0.04	0.14	0
3	0.06	0.13	0	0.78	0.75
4	0	0.86	0.81	0.75	0.66
5	0.75	0.57	0	0.11	0.28

(c) 減去每行的最小值

	1	2	3	4	5
1	0.63	0.72	0	0.05	0.77
2	0.41	0.55	0.04	0.03	0
3	0.06	0	0	0.67	0.75
4	0	0.73	0.81	0.64	0.66
5	0.75	0.44	0	0	0.28

(d) 減去每列的最小值

	1	2	3	4	5
1	0.63	0.72	0	0.05	0.77
2	0.41	0.55	0.04	0.03	0
3	0.06	0	0	0.67	0.75
4	0	0.73	0.81	0.64	0.66
5	0.75	0.44	0	0	0.28

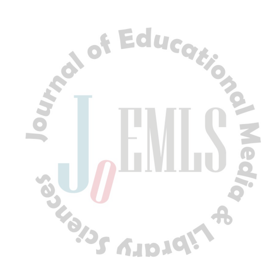
(e) 以最少的線通過所有的0

	1	2	3	4	5
1	0.63	0.72	0	0.05	0.77
2	0.41	0.55	0.04	0.03	0
3	0.06	0	0*	0.67	0.75
4	0	0.73	0.81	0.64	0.66
5	0.75	0.44	0*	0	0.28

(f) 選取單獨只有一個0的行（如圖上的第1行），並標記這些行上的0（如第1行第3列上的0）所在列上其餘的0（如第3列上的0*）

	1	2	3	4	5
1	0.63	0.72	0	0.05	0.77
2	0.41	0.55	0.04	0.03	0
3	0.06	0	0	0.67	0.75
4	0	0.73	0.81	0.64	0.66
5	0.75	0.44	0	0	0.28

(g) 找出配對的項目



Journal of Educational Media & Library Sciences 59 : 2 (2022) : 201-231
DOI:10.6120/JoEMLS.202207_59(2).0014.RS.AM



Research Article

Estimation of Topic Similarity and Its Application to Measuring Stability of Topic Modeling

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Abstract

Topic modeling stability is a measurement of the extent to which models produced by the same modeling approach for the same corpus and with the same initial conditions have similar topics. Since the method used for calculating similarity between topics is considered the basis for measuring topic modeling stability and topic alignment is a key step in the measurement, the present study first calculated the proportion of identical paired topics among the optimal combinations of paired topics generated using different topic similarity calculation methods, and then observed the distribution of similarity scores of paired topics for each method. Finally, this study performed an analysis of the effects of the number of topics on topic modeling stability. The topic modeling method used in this study is commonly used LDA topic modeling, and the corpus used to establish topic models including about 30,000 posts was collected from the PTT Bulletin Board System (BBS) Book message board. The results indicated that there is a high proportion of identical paired topics among the different methods of measuring similarity, although the similarity scores of paired topics for each method had different distributions due to the different kinds and amounts of information of word distribution in each topic they used. The results also revealed that with the increase of the number of topics, the stability noticeably decreased.

Keywords: *Topic modeling, latent Dirichlet allocation (LDA), Stability measurement, Topic similarity estimation, Topic alignment*

SUMMARY

Introduction

Topic modeling can reveal topic structures contained in a corpus and aid in the rapid and effective analyses of large amounts of text. Currently, latent Dirichlet allocation (LDA; Blei et al., 2003) is regarded as the most popular topic

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Please visit JoEMLS website to read the Peer Review Report (Open Point) and Article Summary (InSight Point) of the article.

2022/05/02 received; 2022/07/29 revised; 2022/07/30 accepted

modeling technique among researchers and is widely used for problems involving text analyses (Lancichinetti et al., 2015). However, in practice, even with the same parameters and corpus, the models produced with this technique somewhat differ from each other, calling into question the reliability of the analysis results (Maier et al., 2018). This problem casts doubt on the usefulness of LDA topic modeling (Belford et al., 2018; Chuang et al., 2015).

Topic modeling stability is a measurement of the extent to which models produced by the same modeling approach for the same corpus and with the same initial conditions have similar topics. Several methods can be used to measure topic modeling stability. For instance, in the present study, the framework used for measuring topic modeling stability (De Waal & Barnard, 2008; Greene et al., 2014) involved producing multiple topic models through repeated modeling with the same corpus and number of topics and then performing topic alignment between any two topic models by using the Hungarian algorithm to determine the optimal combination of topic pairs. In this combination, the mean similarity of the topic pairs was the agreement score of the two models, whereas the mean of the agreement scores was the measurement of the topic modeling stability.

According to this measurement framework, the method used for calculating similarity between topics is considered the basis for measuring topic modeling stability. Belford et al. (2018) and Greene et al. (2014) used Jaccard's score (JAC) to calculate topic similarity; however, their approach considered only a small portion of information in the word distribution of each topic. Therefore, in the present study, the following six methods for measuring topic similarity were used and compared: Jensen–Shannon divergence (JSD), normalized discounted cumulative gain (NDCG), cosine measure (COS), JAC, rank-biased overlap score (RBO), and Kendall's τ coefficient (KEN). Topic alignment is a key step in this measurement framework. If two different methods for measuring topic similarity yield highly similar optimal combinations of topic pairs, the two methods may have similar stability measurement outcomes. The distribution of the similarity score of paired topics can also indicate which methods are more likely to identify the topics that appear in most models after topic alignment.

This study performed the following analysis tasks:

Task 1: Conduct an analysis of the proportion of identical paired topics among the optimal combinations of paired topics generated using different topic similarity calculation methods.

Task 2: Perform an analysis of the distribution of similarity scores of paired topics for each method.

Overall, the study conducted by Greene et al. (2014) is regarded as one of the few studies analyzing the effects of the number of topics on topic modeling

stability. However, the corpus used in that study had few topics, which were already clearly defined. Therefore, a corpus with a greater number of topics was used in the present study.

Task 3: Perform an analysis of the effects of the number of topics on topic modeling stability.

Research Methods

Word segmentation, part-of-speech tagging, and stop word removal were performed on 32,895 posts collected from the PTT Bulletin Board System (BBS) Book message board. Posts containing at least five words were selected to form a corpus for analyzing topic modeling stability. The final corpus included 20,287 posts and 1,579,116 words. The topic modeling inputs consisted of this corpus and a dictionary. For each different number of topics (K = 5, 10, 15, …, 100), a total of 20 models were created with fixed prior parameters α and β.

Next, the six methods of measurement mentioned earlier were used with any two topic models to calculate the similarity between each topic pair. The results of each method were then adjusted to be between 0 and 1. The greater the similarity between any two topics was, the greater the score was. The similarity scores of all pairs of topics between every two models were then entered into the Hungarian algorithm to align the topics and obtain an optimal combination of topic pairs. Analysis Tasks 1 and 2 were then performed.

Finally, the agreement score between every two topic models was obtained by averaging the optimal topic pair similarity scores. Analysis Task 3 was then performed using the mean agreement score between each pair of topic models as the stability measurement.

Research Result

Task 1

This task involved assessing whether different methods of measuring similarity had the same effect when measuring stability based on the proportion of identical topic pairs in the optimal combinations of topic pairs. The results obtained indicated a high proportion of identical paired topics among the different methods of calculating topic similarity. The proportion of identical paired topics among the six methods reached 76.99%, and the total proportion even increased to 94.09% in four or more methods. For any two methods, the proportion of identical topic pairs was 84% or higher, suggesting that any two methods had similar stability outcomes. However, slight differences were observed between the methods that involved the use of all word distribution data, such as JSD, NDCG, COS, and KEN, and the methods that involved only a few keywords, such as JAC and RBO.

Task 2

If a method for calculating topic similarity can yield a high similarity score between postalignment paired topics, then this means that this method can differentiate between similar topics within different models and thereby identify stable topics in each model. In this study, rather high similarity scores were observed among most of the paired topics when JSD, NDCG, and COS were used, which are methods that involve the use of the occurrence probability of all words in each topic, showing that these methods can easily identify stable topics in models. JAC and RBO are methods that involve the use of a set of keywords to represent topics. In this study, these two methods yielded similarity scores that were scattered across a wide range. In addition, approximately 5% of the similarity scores were 0, because the corresponding paired topics had completely different keywords. The KEN method considers every word to have a consistent order of occurrences among paired topics. However, each topic contains several irrelevant and low-probability words, which may cause similar topics to exhibit dissimilar orders and hence lower the similarity scores.

Task 3

This task entailed measuring the stability of topic models with different numbers of topics. The results revealed that with the increase of the number of topics, the stability noticeably decreased. This may be because with the increase of the number of topics, the topic ranges in the model became narrower, and the distribution of words in the topic became more prone to change. This may have resulted in an increasing number of topics being unable to align with similar topics in another model, thereby lowering the stability.

Suggestions and Future Research

In this study, topic alignment was performed using the Hungarian algorithm, and the agreement score between models was calculated on the basis of the similarity scores between paired topics. Future researchers may refer to Maier et al. (2018) and use the proportion of possible pairs as an indicator of model stability to develop a method of measurement that is suited to direct interpretation.

During text analyses with topic modeling, the number of topics is considered a key parameter that determines the scope, accuracy, and interpretability of the model. Several studies have employed perplexity or topic coherence as an indicator of topic model quality to determine the optimal number of topics, and some have even involved manual reviews (Maier et al., 2018). Therefore, we suggest integrating stability with other quality indicators to determine the optimal number of topics.

Finally and most importantly, the methods used to improve topic modeling stability should be further developed. Increasing the level of stability can help increase the possible similarity in topics among all models produced under the same input conditions and thereby enhance the reliability of the text analysis results. Among the current studies investigating this topic are those of Chuang et al. (2015), Lancichinetti et al. (2015), Koltcov et al. (2016), Agrawal et al. (2018), Maier et al. (2018), and Mantyla et al. (2018).

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[1] 相關說明另見邱炯友，「編者言：期刊稿件倫理爭議處理之思考」，教育資料與圖書館學 53卷，2期（2016年春季號）：135-138。

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   範例2－參考文獻（References）
   林雯瑤、邱炯友（2012）。教育資料與圖書館學四十年之書目計量分析。教育資料與圖書館學，*49*（3），297-314。【Lin, Wen-Yau Cathy, & Chiu, Jeong-Yeou (2012) A bibliometric study of the *Journal of Educational Media & Library Sciences,* 1970-2010. *Journal of Educational Media & Library Sciences*, *49*(3), 297-314. (in Chinese)】

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Tamkang University Press
Taiwan

ISSN 2309-9100
ISSN-L 1013-090X



